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ARTICLE I.

SARCOMA OF THE LONG BONES; BASED UPON A STUDY OF ONE HUNDRED AND SIXTY-FIVE CASES.

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In the last edition of his work on "Surgical Pathology," Professor Billroth states that "the subdivisions, made according to the histological peculiarities of the various sarcomata, are of no great value during life;" but being convinced, from personal observation, that clinical differences exist among the divisions of sarcoma as marked as are met with among the varieties of carcinoma, I have ventured to differ from so distinguished an investigator, and have studied these growths, as all morbid processes should be studied, with the view of determining the relations subsisting between their minute structure and their clinical characters. To attain this end I have carefully analyzed one hundred and sixty-five cases, many of which are original, and the number might have been very materially increased had I included examples of mixed sarcomas. I have limited my investigations, however, to those cases alone in which the histological features of each form of sarcoma were typical, and I have used none, except a few of osteoid sarcoma, about the true nature of which there could be no doubt, that were not confirmed by microscopical examination.

The primary neoplasms of the long bones, exclusive of the clavicle, the metatarsal and metacarpal bones, and the phalanges, which I shall not consider, are, in the order of the frequency of their occurrence, sarcomas, osteomas, chondromas, osteoid chondromas, fibromas, and myxomas. Vascular and cystic growths, as I shall have occasion to show hereafter, are, for the most part, nothing more than metamorphosed sarcomas, while it is extremely doubtful whether primary carcinoma ever occurs in the osseous system. Since sarcomas affect the long bones more frequently than all the other tumours combined, and as they constitute an important group of morbid growths which are not thoroughly understood, and are described under a great number of different and confusing names, I shall devote this and a succeeding paper to a description of their histology, general pathology, symptomatology, diagnosis, prognosis, and treatment, covering, as far as possible, the entire field, although in doing so I will touch upon some points which may be considered elementary, but which I trust may prove to be instructive to those not entirely familiar with the subject.

The term sarcoma, which is of very ancient date, and was employed by Abernethy to designate tumours "having a firm and fleshy feel," was revived by Virchow, and is now employed by him and other pathologists and most surgeons to indicate a new formation of the connective tissue series, which is composed almost entirely of unripe, transitional, or embryonic cells, which serve to distinguish it, on the one hand, from the perfected tumours of that system, and, on the other, from the carcinomas. From the excessive preponderance, development, and mode of arrangement of its cellular constituents, which endow it with its peculiar characters, and from their indisposition to pass into higher tissues, they constitute a structure which is unlike any natural structure, and may, therefore, be regarded as an atypical production. The cells are contained in an intercellular substance, which is hyaline, granular, fibrillated, or alveolar, which, along with the various degenerations to which these tumours are liable, give rise to certain subdivisions. The principal varieties of sarcoma of the bones, which are determined by the prevailing form and size of their cellular elements, are the round-celled, the spindle-celled, and the giant-celled, the cells themselves merely representing different stages of development. In accordance with the dimensions of the cells, they are, moreover, separated into the small-celled, and large-celled, a distinction which is most useful, not only because the size of the cells influences the consistence of the tumours, but from the fact that it has a special bearing upon the prognosis.

Certain subdivisions of sarcoma are constituted by the nature of their matrix or intercellular substance, by their transformations, and by their vascularity. Thus, when fibrous tissue replaces in great part the ordinary intercellular substance, the growth is called a fibrous sarcoma. When the basis substance has undergone mucoid transformation, it is a myxomatous sarcoma; when it presents the appearance of the reticulum of the lymph glands, it is known as lymphadenoid sarcoma; when it forms an alveolar structure, it is an alveolar sarcoma; when the cells have undergone fatty degeneration and granules of fat and free oil are disseminated in the intercellular substance, it is a lipomatous sarcoma; the presence of certain other constituents, as the mineral salts, bone, or cartilage, produces respectively calcifying, ossifying, and chondroid sarcomas; when they have undergone cystic degeneration, they are known as cystic sarcomas; excessive vascularity gives rise to telangiectatic sarcoma; and effusions of blood, to hemorrhagic sarcoma. All these subdivisions, pure or variously intermixed, are met with in the sarcomas of the long bones, the only one that is missing being pigmented or melanotic sarcoma, of which I have been unable to find a single recorded example.

Sarcoma of the bones is generally denominated osteosarcoma, but the latter term, which is employed by clinicians, should be dropped, since, from a histological standpoint, it signifies a sarcoma, whether it be seated in or on a bone, or in the soft parts, containing osseous tissue of new formations, and is synonymous with osteoid or ossifying sarcoma. As an evidence of the confusion that has arisen from retaining that name, I may mention that Wilks and other English writers call the periosteal osteoid sarcomas osteosarcomas, while many German pathologists employ the term to designate myeloid tumours, which are always central.

According to their point of departure they may be separated into the peripheral, periosteal, or periosseous, and the central, endosteal, intraosseous, or myelogenic, a division which is not only convenient as designating their seat, but which is also justified by the fact, that, in general, they present marked differences in their histological construction, and are of different prognostic import. Thus, the majority of the peripheral growths, which proceed from the layer of embryonic cells, or osteoblasts, which separates the periosteum from the bone, and is variously known as the osteogenic substance of Ollier, the ossification blastema of Kölliker, the proliferating layer of the periosteum of Virchow, and the cambium layer of the bone of Max Schultze, are osteoid spindle-celled growths, while the central tumours, which develop from the medulla, and from the osteoblastic layer which lines the interior of the medullary canal, are, as a rule, giant-celled sarcomas.

In their macroscopic or gross appearances these two divisions of sarcoma present some points of difference which may be utilized for diagnostic and prognostic purposes, in the absence of microscopical examination. The central tumours, particularly those of the giant-celled variety, are inclosed in a capsule or case, which may be entirely bony, but which is usually partly bony and partly membranous. The periosteal formations, on the other hand, are limited by the outer fibrous layer of that membrane, or, in the event of its participation in the proliferation, by a capsule of connective tissue. In either event, osseous tissue is never found in the investing membrane, so that the presence or absence of bone in the capsule is of great value in the determination of the original seat of the new growth.

Although the sarcomas are very liable to certain transformations which tend to obscure their diagnosis from their naked-eye appearances, yet, in their pure forms, their structure is so dissimilar, that we may judge pretty accurately of their nature by their tints and consistence. Thus a tumour which presents a dark red or maroon colour can be nothing else than a giant-celled sarcoma. Specimens which are characterized by a firm, glistening, grayish-white tissue come under the subdivision of large spindle-celled sarcoma. When there is an admixture of bony spicules and soft tissue, there need be no doubt as to its osteoid nature; should the soft portion be dense and firm, it may be termed an osteoid fibrous sarcoma; if it be soft and medullary, it will probably turn out to be an osteoid round-celled tumour; while, if it be semifluid and gelatinous, it forms a myxomatous osteoid sarcoma. Tumours which have the consistence and appearances of the brain of a newly-born child may be ranked among the medullary or encephaloid sarcomas of the small round-celled type, although the soft, small spindle-celled tumours present precisely similar features. When the tissue looks like a recent coagulum, or contains one or more cysts filled with blood, we will be right in assuming that we are dealing with a highly vascular medullary growth. These conclusions are based upon the combined clinical and microscopical characters of sarcomas, and may be held to be as true for this group of neoplasms as it is true that the gross characters of scirrhous carcinoma, for example, correspond to a known type of structure.

In their configuration, sarcomas of the long bones vary in accordance with their situation. Central tumours, whether they occupy the epiphyses or diaphyses, are generally spherical. Periosteal tumours are long, oval, or fusiform, when they occupy the shafts; while they are pyriform, with their base towards the articulation, when they surround the articular ends of the long bones; or conoidal, when they develop from a limited portion of the joint-end. Their surface is usually smooth and even, although it may be tuberous, bossed, or lowly-lobed, which is particularly liable to be the case when their investing capsules are implicated in the new formation, and when they have softened, and are about to become the seat of ulceration. Their volume varies very greatly. They may be no larger than a walnut, or they may attain huge dimensions, as, for example, three feet in circumference. In the latter event, it may be assumed that the growth is the seat of interstitial hemorrhage or cystic transformation.

So long as they are circumscribed by their investing capsules, sarcomas merely stretch and push aside the surrounding tissues; but when their capsules take part in the cell proliferation, or are perforated, they evince a locally infectious nature, and become diffused, either through the conversion of the cells of the tissues into like elements, or through the continuous multiplication of the tumour elements. In the peripheral sarcomas, the bone generally passes through the growth unchanged. In some in stances the cortex of the compact substance is the seat of condensing sclerosis; in others, it is eroded, pitted, or, as it were, worm-eaten. In others, infection of the compact tissue ensues without changes in its outer surface, through which nodules are formed in it, and give rise to what may be termed interstitial sarcoma, although I have never known a tumour to originate primarily in this situation. Again, the disease may extend along the Haversian system to infect the medulla. Finally, the tumour may occupy all these localities, so that we may even find a sarcoma which has originated in the periosteum constituted as follows: masses in the medulla, interstitial deposits in the compact tissue, a large tumour around the shaft, and, finally, one growing from the fibrous layer of the periosteum, the last two of which are merely separated and cut up into lobules by the remains of that membrane. In the central sarcomas, the original bone is usually destroyed to such an extent that not a vestige of it remains.

Next to the carcinomata of the soft parts, the sarcomata of the bones are the most malignant of all neoplasms, as is evinced by the local infection of the adjacent tissues, the occasional implication of the associated lymphatic glands, and the occurrence of secondary deposits in the viscera and tissues belonging to the same series. From their tendency to infiltrate the surrounding structures, they show a great disposition to recur locally after extirpation, so that in the performance of an operation for their removal, the rule should be to amputate as far as possible from the seat of the disease. Unlike the carcinomata, the lymphatic glands are rarely the seat of primary contamination. Thus, of one hundred and thirty-three cases in which this point is noted, these organs were enlarged in only twenty-three. In thirteen of these the lymphatic tumour was merely due to irritation, as was shown by the fact, that in some cases it disappeared after the removal of the primary neoplasm, while, in others, minute examination failed to detect carcinomatous elements. In five fatal cases, the condition of the glands was not noted; while, in only five, were they converted into a tissue similar to the parent growth. These facts are of extreme interest, as they denote, in the first place, that enlargement of the lymphatic glands should not be regarded as a bar to operative interference, and, secondly, that systemic infection generally takes place through the blood and not through the lymph channels.

The general dissemination of sarcoma, or the occurrence of secondary growths in the viscera and in other tissues, is one of the most marked attributes of this class of morbid growths. Thus I find that 46.06 per cent. of all cases are characterized by this clinical feature, the metastatic tumours being found most commonly in the lungs, lymphatic glands, and other parts of the osseous system. In this connection it should be remembered that the secondary deposits are histologically identical with the primary growth. Through ignorance of this fact, it is not uncommon to find writers describing a case, for example, as one of sarcoma of the femur with secondary cancerous deposits in the lungs, whereas, in truth, the latter do not deviate in their structure from the original tumour. A sarcoma always reproduces its like, a carcinoma its like, a chondroma its like, so that the anatomical peculiarities of a metastatic deposit enables us to decide as to the nature of the original tumour in the event of the latter having been removed by some other surgeon. A naked eye point of distinction between the secondary carcinomatous and sarcomatous growths, as of the liver, is the presence of umbilication in the former, and its absence in the latter.

While it is true that the sarcomas of the bones are to be regarded as malignant affections, yet the signs of malignity—that is to say, infection of the neighbouring tissues and local recurrence, extension to the lymphatic glands, and multiplication in distant parts—are not witnessed in the same degree in the different varieties of sarcoma, as is shown by the following table:—

VARIETY.	Adjacent Tissues.[1] Per cent.	Local Recurrence. Per cent.	Extension to Glands.[2] Per cent.	Generalization. Per cent.
Periosteal spindle-celled	44	60	0	100
" round-celled	50	50	7.69	66·66
" osteoid	40	41	6.25	65.62
Central round-celled	66	25	8.33	33.33
" spindle-celled	18	20	0	23.07
" giant-celled	12	8	0	22.72

From an examination of the cases of destructive sarcomas, they may be classed, in the order of their malignity, as follows: Periosteal spindle-celled, periosteal round-celled, periosteal osteoid, central round-celled, central spindle-celled, and central giant-celled; the periosteal forms being more malignant by 43.5 per cent., as will be pointed out hereafter. Hence the comparative benignity of the central tumours may, to a certain extent, be ascribed to the slight disposition which they evince to extend beyond their bony or osteo-membranous capsules. With regard to the sarcomas composed of spindle cells—and they are synonymous with the recurrent tumours of Paget—it will be observed that they are endowed with the power of general dissemination to an extraordinary degree, so that the term recurrent, as designating the characteristic peculiarity in their history, is in nowise applicable to them.

Sarcomas of the long bones evince a great predilection for their articular extremities, and the majority develop in the spongy substance of the epiphyses. Whether of central or peripheral origin, they are liable, even in the hands of the most skilful observers, to be confounded with other affections, such as aneurism, white swelling, strumous abscess, periosteal abscess, osteomyelitis, and gummata. Of these, aneurism of the bones and strumous articular osteitis have given rise to the greatest number of mistakes. They may be discriminated from abscesses by the exploring needle, and from syphilitic formations by the history of the case. Osteomyelitis, in addition to the tumefaction, gives rise to puffiness of the superincumbent soft structures, and is attended with irritative fever, and, now and then, with deep-seated throbbing pain.

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[1] Infection of surrounding tissues as shown on dissection of the limb after its removal.

[2] Instances of enlargement of the glands from irritation are excluded. Compare with page 21.

From aneurism of the long bones, if there is really such an affection, and its occurrence is denied by Virchow,[1] Landi,[2] and Broca,[3] the distinction is by no means always easy, particularly when, in addition to the pulsation, there is a bruit, as happened in four instances to which I shall call attention hereafter. In the majority of pulsating sarcomas there is no murmur, or, if it be present, it is not very distinct. Then, too, in sarcoma, pulsation is not found from the very commencement, nor is it expansile, and in some cases it is not remarked until the tumour begins to grow rapidly. Aneurisms, as is well known, are extremely rare before the thirtieth year, while two-thirds of the pulsating sarcomas occur before that age. Finally, when a pulsating growth is situated away from the line of a large vessel, as, for example, in the upper epiphysis of the fibula,[4] it is far more likely to be a sarcoma than an aneurism.

White swelling is very liable to occasion mistakes in the diagnosis, and this is particularly true of those cases in which the adjacent joint has undergone destructive changes from nutritive disturbances, or has been invaded by the growing tumour, when the symptoms are so similar that a differential diagnosis, without exploratory incision, is scarcely possible.

White swelling, as of the knee, for example, usually occurs in scrofulous subjects before the fifteenth year. There is pain from the very outset, which gradually increases in severity, and finally becomes so intense as to deprive the patient of sleep and seriously undermine his general health. The skin is tense and glossy; the superficial veins are abnormally large; the temperature is elevated; the joint is stiff, if not immovable, and efforts at motion produce great suffering; the articulation, moreover, is distorted and flexed; and puncture gives vent to pus or turbid synovial fluid containing flakes of lymph. White swellings do not pulsate, nor does manipulation elicit parchment-like crepitation.

In sarcomas, the absence of suppuration, or the slight tendency to the formation of pus, is a sign of great value. Other important distinguishing features of sarcoma are the preservation of the movements of the joint, although in some cases the mobility is limited, freedom from suffering on motion, and absence of vicious position. In many cases, indeed, the patients are able to walk about without suffering or experiencing particular fatigue. In sarcoma, too, spontaneous fracture is not uncommon. Resistance to ordinary treatment, moreover, distinguishes sarcoma from white swelling. In the latter affection, rest and extension, along with gentle and equable compression of the joint, are of great benefit in relieving the pain and in restoring the impaired general health ; but in sarcoma, the tumour continues to grow despite the employment of these measures, and the local suffering is greatly increased by compression. These features, which have been carefully studied by Gilette[1] and Poinsot,[2] when considered in connection with the symptoms previously referred to, will generally suffice to differentiate the epiphyseal sarcomas from strumous articular osteitis.

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[1] Pathologie des Tumeurs, vol. iv. p. 68.

[2] Amer. Journ. Med. Sciences, January, 1878, p. 278.

[3] Traité des Tumeurs, vol. ii. p. 212.

[4] Langenbeck. Langenbeck's Archiv, vol. xxi., supplement, p. 333.

Sarcomas of the long bones are most frequent in those of the lower extremity ; the femur, tibia, and fibula being affected in 76 per cent. of all cases. Thus—

Out of 165 cases which I have analyzed,

The femur was the seat of the disease in 67 instances.
The tibia " " " " 46 "
The humerus " " " " 25 "
The fibula " " " " 13 "
The ulna " " " " 7 "
The radius " " " " 6 "
The ulna and radius were the seat of the disease in 1 instance.

Separating these in accordance with their histological construction :—

70 were examples of giant-celled sarcoma.
45 " " periosteal osteoid sarcoma.
16 " " central spindle-celled sarcoma.
13 " " periosteal round-celled sarcoma.
12 " " central round-celled sarcoma.
9 " " periosteal spindle-celled sarcoma.

Hence it follows that the giant-celled tumours are the most common, forming, as they do, 42 per cent. of the entire number. It will also be seen that the central tumours are more frequent by 18 per cent. than those which arise in the periosteum.

Males are more liable to their occurrence by 17 per cent. than females, as is shown in the following table of 149 cases in which the sex is given :—

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[1] Bull. et Mém. de La Soc. de Chir. de Paris, vol. ii. 1876, p. 115.

[2] Ibid. vol. iii. 1877, p. 208.

Nature of Tumour.	Males.	Females.
Central giant-celled	33	30
" round-celled	7	5
" spindle-celled	11	5
Periosteal round-celled	10	3
" spindle-celled	4	5
" osteoid	22	14
	87	62

The age at which they first manifest themselves averages 27 years. In the following table of 147 cases in which the age is denoted, I have separated their occurrence at the different epochs of life, from which it will be seen that 68 per cent. develop before the 30th year, and 32 per cent. after that period :—

Between 10 and 20 years of age	45 cases.
" 20 " 30 " "	55 "
" 30 " 40 " "	26 "
" 40 " 50 " "	11 "
" 50 " 60 " "	7 "
" 60 " 70 " "	3 "

Sarcomas of the long bones appear to be influenced in their histological construction by the age at which they appear. With the exception of the central spindle-celled, which are most common after the thirtieth year—the average being the thirty-sixth year—they all develop before that age, the mean being twenty-two for the periosteal osteoid, twenty-three for the periosteal round-celled, twenty-four for the periosteal spindle-celled, twenty-eight for the central round-celled, and a fraction above twenty-eight for the giant-celled.

Traumatism was the assignable cause in nearly one-half of the 144 cases in which the etiology is recorded. They could be traced to blows, falls, kicks, sprains, fractures, and other injuries in

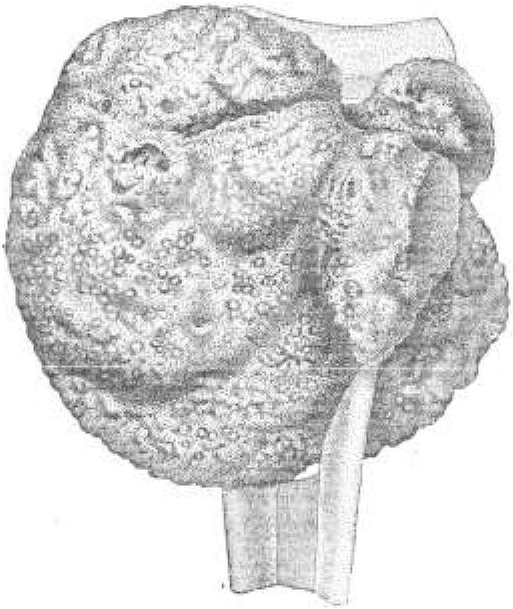
31	out of	60	cases of	giant-celled sarcoma.
2	"	12	"	central round-celled sarcoma.
4	"	16	"	" spindle-celled sarcoma.
7	"	13	"	periosteal round-celled sarcoma.
16	"	34	"	" osteoid sarcoma.
3	"	9	"	" spindle-celled sarcoma.

Having thus directed attention to what I consider to be some of the more important points in the general pathology and diagnosis of these new formations, I will now take up the study of the individual sarcomas, in which these data will receive more extended consideration.

1. GIANT-CELLED SARCOMA.

Of the central, intraosseous, endosteal, or myelogenic sarcomas of the long bones, by far the most interesting, from their relative frequency, comparative benignity, and the large size of the cells of which they are mainly composed, are those denominated myeloid tumour by Paget,[1] myeloplaxic tumour by Eugène Nélaton,[2], and giant-celled sarcoma by Virchow.[3] Before the essential elements of these growths were first accurately described by Robin,[4] although they had previously been recognized by Müller[5] and Lebert,[6] giant-celled sarcoma was, in accordance with its external characters or clinical peculiarities, generally ranked under the names of spina ventosa, spleen-like tumour, cancer of bones, fungus hematodes, erectile or aneurismal tumour of bones, spongy tumour, hematoid tumour, encephaloid tumour, and osseous cysts; and even at the present day it is not uncommon for German writers to describe it merely as osteosarcoma. To avoid confusion, I shall refer to it as giant-celled or myeloid sarcoma, as these terms are in common usage.

Fig. 1.



Of the seventy examples of giant-celled sarcoma, which I have collected and analyzed for the purpose of elucidating the structure and general history of this variety of morbid growths, the most remarkable, from its volume, chronicity, and the advanced age at which it occurred, is that illustrated by fig. 1, reduced nearly three-fourths from a specimen which was removed after death, and presented to the Museum of the College of Physicians by Dr. R. E. Brown, of Mount Holly, New Jersey. Its history is as follows:—

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[1] Lectures on Surgical Pathology, 1853.

[2] D'une Nouvelle Espèce de Tumeurs Bénignes des Os, ou Tumeurs a Myéloplaxes. Paris, 1860.

[3] Die Krankhaften Geschwülste, vol. ii. p. 213.

[4] Comptes Rendus de la Soc. de Biologie, 1849, p. 119.

[5] Ueber den feinern Bau und die Formen der Krankhaften Geschwülste, Berlin, 1838, p. 6.

[6] Physiologie Pathologique, T. ii. p. 120, 1845.

I. M. S., 67 years of age, of full, plethoric habit, came under the care of Dr. Brown in December, 1871, on account of loss of muscular power, principally of the right side, which was shortly followed by general erysipelas, from which he succumbed in six weeks from commencement of his illness. During the past twenty-five years of his life Mr. S. had repeated attacks of erysipelas, and chronic ulcers were seated on both legs. Ten years previous to his death, whilst stepping off a street car, he slipped and twisted the left knee, the accident being attended with pain, and succeeded, a few days subsequently, by inflammation, as denoted by slight redness, swelling, and stiffness. At the expiration of six weeks, a soft tumour, as large as a hen's egg, was detected over the anterior and inner aspect of the joint; the discoloration of the integument gradually disappeared, but the pain persisted, although it was never so severe as to demand the use of large doses of opium. The new growth increased very gradually and measured thirty-two inches in its greatest circumference, at the time of the patient's decease. Its surface was hard, inelastic, and nodulated; the skin was somewhat tense, but of a natural hue; the subcutaneous veins were not dilated, nor could any enlargement of the popliteal, femoral, or inguinal glands be detected. The knee was semiflexed, but admitted of limited movement.

The head and upper portion of the shaft of the tibia, which include about two-fifths of the entire bone, form an irregular spherical osseous case, perfect at all points, and covered by the periosteum. The half of the mass from which this description is taken, is divided into three noduled, convex lobes, of which the anterior and largest is limited behind by the insertion of the sartorius muscle, the middle is included between that structure and a deep furrow which corresponds to the inner border of the gastrocnemius, while the posterior lobe is covered by the belly of the latter muscle. The middle lobe terminates above in a prominent spine, into which the semimembranosus muscle is inserted. All of the muscles and tendons that are in relation with the bony capsule are greatly thinned and fatty, while the ligament of the patella is much elongated and expanded into a thin membranous sheet which is merged into the periosteum. The osseous shell varies from $\frac{1}{16}''$ to $\frac{1}{2}''$ in diameter, the average being $\frac{1}{12}''$, and in the thickest portions are cavities filled with the tissue presently to be described. The great size of the mass may be inferred when it is stated that it is 9″ in diameter, and that the distance between the tendon of the sartorius and the middle line is 7″, so that the neoplasm grew principally at the expense of the anterior and lateral portions of the head of the tibia. The anterior segment of the articular surface of the tibia forms a deep, hemispherical, or cotyloid depression for the reception of the condyles of the femur, and its investing cartilage is everywhere perfect, although excessively thin. The joint itself is free from disease, but its motions are limited by the greatly enlarged spinous process. The femur and the remainder of the shaft of the tibia are infiltrated with fat. In its fresh state, the soft portion of the tumour was composed partly of a moderately firm, dark-red tissue, which bore a striking resemblance to coarse muscular fibre which had been exposed to the air, and partly of a dark-red grumous or pulpy substance. Scattered throughout it were numerous cysts or cavities, both single and multilocular, which varied in size from a small hazel-nut to a Sicily orange, were circumscribed by fibrous tissue, and filled, for the most part, with fluid, semifluid, and clotted blood, only a few containing a straw-coloured liquid.

In addition to the large mass, the cancellous tissue of the anterior segment of the shaft of the tibia was occupied by a circumscribed tumour, as large as a pullet's egg, and separated from the original growth and from the medulla of the shaft by a distinct partition. In its recent state, it was of pretty firm consistence, and of a pinkish tint, mottled with spots of crimson and straw color, the pinkish hue being still apparent in the wet section. Anteriorly, the partition is composed of bone, but it is fibrous where it crosses the medullary canal, and is continuous posteriorly with the incurvated shaft of the tibia, which appears as if it had been weighed down by the superincumbent mass. There was no enlargement of the popliteal or femoral glands.

In its gross appearances the tumour, therefore, corresponds with the myelocystic tumour of Mr. Henry Gray,[1] and with the fibroid variety of encysted intraosseous myeloplaxic tumour of Nélaton.[2]

Minute examination of the principal mass failed to disclose the characteristic structure of myeloid sarcoma. Blood corpuscles were found in large numbers, and fibrous and large spindle-celled tissue, along with round and ovoid cells, all in an advanced stage of fatty degeneration, were abundant. In order, if possible, to obtain better sections, I removed, with the saw and knife, a portion of the posterior segment of the tumour, but there was little variation in the constituent elements. The spindle-celled tissue, in the form of interlacing bundles of closely aggregated fusiform cells, was most marked, but giant elements were very decidedly in the minority.

Entirely different from the histological construction of the old tumour was that of the small growth in the shaft of the tibia. This was seen to be a perfect specimen of giant-celled sarcoma, the polynucleated cells constituting the greater portion of the entire structure, and being distributed among a spindle-celled tissue as delineated in Fig. 2, for which I am indebted to my friend Dr. Shakespeare. They were mostly ovoidal and flask-shaped, and contained from three to forty or fifty ovoidal nuclei. In many cells the nuclei were wanting, more or less numerous drops of oil having replaced them.

Myeloid sarcoma is composed of a stroma of spindle and round cells, but particularly the former, in which the characteristic multinucleated elements are imbedded, with the intervention, usually, of little, if any, visible intercellular substance. The tissue has, therefore, an apparently alveolar construction, and its likeness to alveolar structure is the more striking if the cells have undergone mucoid softening, or have become obscured by advanced fatty changes. In other examples the intercellular substance is dimly granular, gelatinous, or even fibrous.

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[1] Med.-Chir. Trans., 2d ser. vol. xxi. 1856, p. 121.

[2] Op. cit. p. 256.

The giant-cells themselves, which are synonymous with the mother-cells of Müller and the osteoclasts of Kölliker, are very similar to those found normally in the medulla of growing bones, especially in the spongy substance, where they are present in greatest number on the surface or at the point of contact of the marrow with the osseous tissue. Like the latter, they are made up of finely granular protoplasm, in which many round or ovoid nuclei are contained; but they differ from them in their relatively large size, sometimes reaching the enormous diameter of $\frac{1}{100}''$ or even $\frac{1}{50}''$, in the greater number and clearness of their nuclei, which are rendered more apparent by the addition of acetic acid, and in the variety and oddity of their forms, which it is impossible to describe. The contour of the cells seems to be influenced by the density of the intercellular substance, being irregularly spherical, ovoid, or lobulated, when the latter is soft, and provided with numerous filiform, branched, or clavated processes, through which contiguous cells are occasionally united, when it is fibroid, in consequence of the protoplasm extending itself into the interstices of the fibrillæ. They also not infrequently present a reddish-brown discoloration, to which the peculiar tint of the tumour of which they form a part is in some degree due.

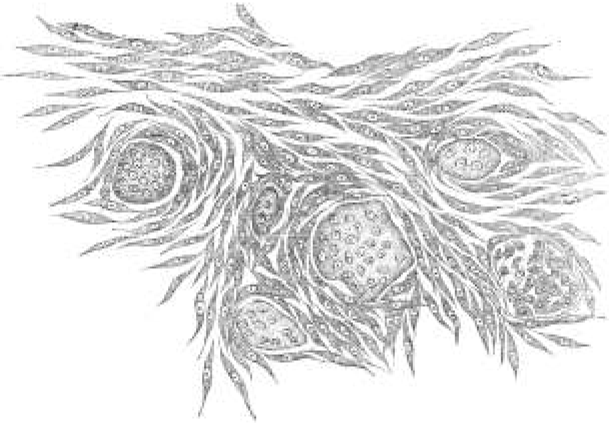

Fig. 3.

Although, as has been stated, large multinucleated cells are found in the medulla of the spongy substance, and, indeed, in the cambium layer of the periosteum and in a similar layer which lines the central medullary canal[1] of actively growing bones, the origin of these bodies in myeloid sarcoma cannot be referred, as is done by Robin and Nélaton, to a hyperplastic process or to a numerical increase of preëxisting giant cells. In point of fact the tumours, in the composition of which they are the essential elements, so far from being peculiar to early life, are, as I shall presently show, comparatively rare before the twentieth year, almost four-fifths of the entire number occurring after that age, at which period myeloid cells are seldom, if ever, seen in the epiphyses of the long bones. Mr. Henry Gray[1] states that he has never met with them after the eighteenth and nineteenth years, and in both of these cases their presence seems to have been due to the return of the marrow to its red or fœtal state in consequence of disease about the knee-joint. If the cells present in these tumours are the original cells of the medulla, such neoplasms should surely be observed most frequently in subjects of tender years.

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[1] Dr. M. Fehr, Langenbeck's Archiv, vol. xvii. p. 232.

In searching for the histological elements from which giant cells originate, it becomes necessary to inquire into the mode of development and growth of myeloid sarcoma. In consequence of irritation, traumatic or otherwise, the marrow of an areola of the spongy substance or of an Haversian canal, reverts to its fœtal state. This is accomplished through multiplication of its essential and accessory elements, namely, the medulla cells, the osteoblasts, the cells of the perivascular connective tissue, the multinucleated cells, and the wandering leucocytes, and through the disappearance of the fat from the adipose vesicles. In this way is formed the indifferent, small-celled, or granulation tissue which constitutes the starting point of nearly all neoplasms. In order that space may be made for the increase of the new tissue, the matrix of the bone is softened down, its earthy matters, or mineral salts, are absorbed, the bone corpuscles are set free and added to the proliferating mass, and irregular spaces or cavities, looking as if the bone had been gnawed out, and known as Howship's lacunæ, in which the sarcomatous tissue is contained, result. Along with this increased activity of the cells and the exudation of nutritive fluid, the capillaries proliferate and give rise to new vessels; and so the process goes on, until a well-defined tumour is formed, the textural disturbances being essentially the same as those witnessed in inflammatory osteoporosis or in fungous or rarefying osteitis.

In its further progress the new material increases at the expense of the spongy substance of the epiphysis in which it is developed, until the original bone finally disappears altogether. As the neoplasm approaches the periosteum it irritates that membrane, setting up chronic ossifying periostitis, through which new layers of bone are constantly being produced, precisely as occurs in the physiological peripheral increase of the bones, to encapsule the growth in an osseous shell or case. As the sarcomatous tissue contiues to increase within the shell, the same liquefactive changes go on in the newly formed bone, as occurred in the original spongy tissue;

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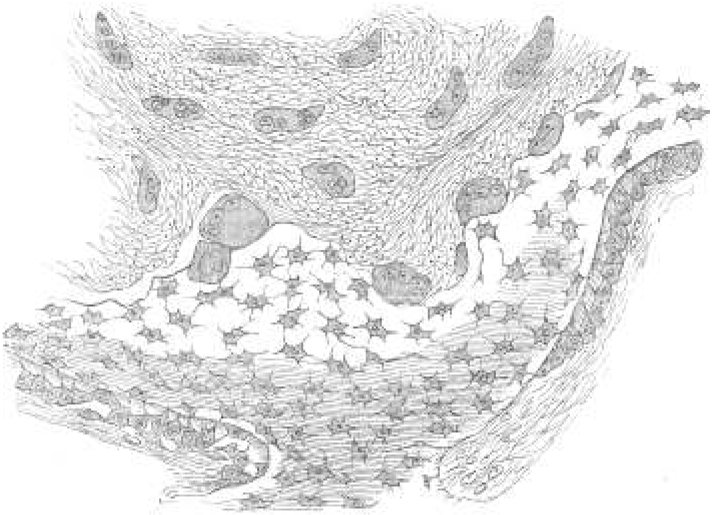
[1] Op. cit., p. 143.

but, as it disappears from within, new osseous layers are simultaneously formed by the osteoblastic layer of the periosteum, and, if the process be slow, deposit of new bone goes on *pari passu* with the absorption of the older layers. In this way, as is so strikingly illustrated by the specimen, a more or less perfect osseous capsule is moulded around all central tümours of bone. These histological peculiarities will be best appreciated by a reference to fig. 3, copied from Rindfleisch's *Text-Book of Pathological Histology*, which represents, on the one hand, the bony case in the process of continuous formation by fresh accessions from the osteoblastic layer of the periosteum, and, on the other hand, its disappearance on the side of the growing tumour, which is marked by a well-defined tortuous line, along which the multinucleated cells are lying in Howship's lacunæ.

Fig. 3.



In regard to the specific elements which are concerned in the production of the giant cells, Rindfleisch[1] believes, with Virchow, that they are the bone cells which are set free in the absorption of the osseous tissue, and become hypertrophied through increase of their protoplasm and repeated division of their nuclei. Dr. Oscar Wyss,[2] of Breslau, entertains a similar view, and, further, is of the opinion that the myeloid cells break up into the other cell forms which are found in the neoplasm. Dr. Ziegler,[3] of Würzburg, has traced their production to proliferating bone cells, and believes that they play the part of reserve or unused elements of the tissue which has replaced the bone. In a case of myeloid sarcoma of the condyles of the femur, in which the investing cartilage was thinned and implicated in the disease, Mr. Hulke[1] has described and delineated the direct transformation of cartilage cells into giant cells, and a similar change has been observed by Mr. Macnamara in a tumour of the scapula.[2] Wegner,[3] on the other hand, traces their origin to the proliferation of the endothelium of the walls of the bloodvessels, and believes that they may develop into medulla cells, fibrous tissue, or bloodvessels; while in a very recent paper Malassez and Monod regard them as atypical vessel-forming elements, and denominate the tumours in which they are found angioplastic sarcomas.[4]

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[1] Op. cit., pp. 606 and 608.

[2] Virchow's Archiv, vol. xxxv. p. 413.

[3] Virchow's Archiv, vol. lxxiii. pp. 367 and 374.

While in the present state of our knowledge no objection can be urged against the derivation of giant cells from osteoblasts or the formative cells of bone tissue, medulla cells, the perithelium of the capillaries, or wandering cells, through the multiplication of their nuclei and the increase of their protoplasm, or even from the confluence of the cells of indifferent or granulation material,[5] I am disposed to think that they are nothing more than the liberated and hypertrophied bone cells, in the first place, of the spongy substance in which the growth is developed, and, secondly, of the osseous shell in which it is encased. In fig. 3 the forming and newly formed giant elements are seen so regularly in Howship's lacunæ, along the inner edge of the disappearing bone, that the view of their origin from the bone cells is most alluring.

In support of this opinion reference may be made to the physiological occurrence of giant cells in the developing marrow of young bones, which is, as is well known, formed after the osseous tissue. According to Bredechin[6] and other observers the formation of the medullary cavities is coincident with the absorption of the calcified matrix and the release of the bone cells, which are converted into giant elements. Kölliker[7] has not only confirmed these investigations, but he has shown that myeloid elements are present in and on bones at points where they have been subjected to pressure, hence he terms them osteoclasts, osteophagi, or bone-destroyers, and thinks that they are transformed osteoblasts. Wegner also believes that pressure is the principal condition for the development of giant cells, and he has found them on the dura mater, where it is in contact with the inner surface of the skull, in tumours of the brain, and in hydrocephalus, and on the sacs of aneurisms which had produced absorption of the ribs and vertebræ. I have myself met with them in periosteal sarcomas, attended with slight erosion of the shafts of the long bones, although they were not present in other parts of the neoplasms; and their absence from peripheral sarcomas may be ascribed to the fact that the bones upon which they are seated are not constantly disappearing, as is the case in the central tumours. Rustizky[1] has arrived at similar conclusions, although he does not believe that the absorption of bone is necessarily attended with the production of giant cells. Finally, it may be mentioned that multinucleated elements are found on the provisional or periosteal callus of fractured bones, in caries, necrosis, rarefying osteitis,[2] in the dentine of deciduous teeth, and in granulations growing into bone.

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[1] Archives of Medicine, vol. i. p. 110, and plate 13, fig. 4.

[2] Clinical Lectures on Diseases of Bone, London, 1878, p. 249.

[3] Virchow's Archiv, vol. lvi. p. 523.

[4] Arch. de Phys. Nor. et Path., ser. 2, vol. v. 1878, p. 375.

[5] Giovanni Weiss. Virchow's Archiv, vol. lxviii. p. 59.

[6] Centralblatt für die Medicin. Wissenschaften, 1868, p. 563.

[7] Verhandlg. der Würzb. Physik. Med. Gesellschaft, 1872, vol. ii. p. 4.

A very striking illustration of the derivation of myeloid from bone cells is afforded by a case of sarcoma reported by Bousseau,[3] in a man of sixty, in which a red, denuded, bosselated, and very firm tumour, as large as the fist, seated on the exterior of the head of the tibia, communicated by a narrow pedicle with a mass within the bone. The latter contained large numbers of giant cells imbedded in fusiform and round cells, while the former was composed entirely of spindle-celled tissue.

From the preceding considerations, the pathological significance of giant cells and their relation to the central sarcomata are very evident. Originating as they do from from the bone cells, to constitute a myeloid tumour, they should be present not only at the circumference, but throughout the entire neoplasm, since, in its onward progress, osseous tissue has constantly been absorbed. Hence, as Rustizky states, they merely indicate that bone was a constituent of the matricular tissue of the new growth. On this account, periosteal sarcomas, which contain only a few giant cells at their points of contact with the shafts of the long bones, can readily be distinguished from the true myeloid sarcomas which start from the medulla.

In shape, giant-celled sarcomas are usually spherical or ovoid. Their surface is commonly smooth and regular, although it may be uneven, bosselated, or lowly-lobed, or it may be divided into large nodulated lobes by deep grooves, in which the adjacent muscles, tendons, nerves, and blood-vessels lie. They are distinctly circumscribed, and isolated from the surrounding tissues by an investing capsule, composed of periosteum or of bone, or of both of these tissues. In the majority of cases the cyst is partly bony and partly membranous; in a large number it is entirely periosteal, while, in about sixteen per cent. of all specimens, it forms a perfect osseous shell—the mode of formation of which has already been described—which is commonly thin, delicate, fragile, and crepitant under slight pressure, although, as in the example here recorded, it may attain the thickness of half an inch, and contain cavities filled with sarcomatous tissue.[1] Instead of presenting itself in its usual form of fibrous tissue interspersed with plates of bone, one-half of the capsule may be osseous and the other half membranous, as, for example, in a tumour of the head of the tibia, the upper half of the cyst was made up of the thinned articular cartilage and the periosteum, and the lower half of osseous tissue which was continuous with the shaft of the bone. The relation of the capsule to the surrounding parts is usually very simple, the muscles and other soft structures being merely stretched, thinned, or, perhaps, the seat of fatty changes. Now and then the sheaths of the tendons are converted into thin bony canals, as in a case under the care of Langenbeck,[2] or the tendons, covered by normal synovial membrane, glide in bony canals developed in the osseous shell, as in the case of Larrey.[3] In a unique instance of myeloid tumour of the head of the tibia, recorded by Cadiat,[4] "a species of vast serous burse" isolated the growth from the adjacent tissues.

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[1] Virchow's Archiv, vol. lxix. p. 202.

[2] See a paper by Professor Koenig, of Rostock, entitled "Der Vorgang der Rareficirende Ostitis unter der Einwirkung der Riesenzellen" (Deutsche Zietschrift für Chirurgie, 1873, p. 502).

[3] Bulletins de la Société Anatomique de Paris, 2 ser., vol. xii. 1867, pp. 426 and 640.

On section, the epiphysis of a long bone looks as if it had been replaced by a mass of soft structure, surrounded by a capsule, which is continuous, on the one hand, with the articular cartilage, and, on the other hand, with the periosteum of the shaft, the latter of which terminates abruptly in the midst of the tumour, although, in rare cases, the medulla of the shaft and the neoplasm are separated by a plate or plug of new bone.[5]

The tissue of the tumour itself presents such peculiar appearances that there is usually little difficulty in recognizing myeloid sarcoma with the naked eye. The cut surfaces, in typical specimens, in which the cellular elements have not undergone retrograde changes, are, especially in the more recent portions of the growth, of a uniform dark red, reddish-brown, or maroon colour, not unlike that of coarse muscular fibre which has been exposed to the action of the air, or resembling the tissue of the heart, or the splenic pulp. In other examples, and these are the most common, the tint is rosaceous, pink, or reddish-buff, mottled with spots or blotches of crimson, bright-red, cherry, or dark-brown. When fatty degeneration is far advanced, and this is not infrequent, the material is of an amber, yellowish-white, or light-buff hue, with points of deep-red or crimson colour, or between the pale-yellow or straw tints and the crimson, there are many intermediate shades, thereby producing a remarkable marbled aspect. Now and then the predominant colour is grayish, pearly, glistening, or semitransparent, in which event a large admixture of spindle-celled or fibrous tissue may be looked for. In all specimens there are yellow areas, which indicate fatty degeneration. These areas may surround the more darkly coloured spots, or a large yellow patch may exist in the centre of the dark-red mass.

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[1] Mr. Borlase Childs has reported analogous appearances. Trans. Path. Soc. of London, vol. vii. p. 362.

[2] Langenbeck's Archiv., vol. i. p. 143.

[3] Nélaton, op. cit., Obs. xliv.

[4] Bulletins de la Société Anatomique de Paris, ser. 3, vol. viii. p. 372.

[5] Cadiat, op. cit.; Brodie, Med.-Chir. Trans., vol. xxxix. case 3, p. 129; and page 28 of this paper.

Giant-celled sarcomas vary very much in their consistence, the majority possessing that of muscular tissue, although they are easily crushed, while others are soft and pulpy. The firmer forms owe their consistence to young or mature fibrous tissue, while the softer forms find their explanation in fatty transformation.

They are not so vascular as one might be led to expect from their more or less rapid growth, large size, and the interstitial hemorrhages to which they are so liable. As a rule, no large arteries enter, and no large veins emerge from, the tumour, so that the circulation is essentially capillary. In exceptional cases, however, the development of bloodvessels is so excessive, that the tissue seems to be saturated with blood, or is the seat of extensive extravasations, for which reason the term fungus hematodes has been applied to them. The vessels, indeed, may be so large as to impart pulsation to the mass, whence the names telangiectatic sarcoma and aneurism of bone, although, in the majority of the pulsating myeloid sarcomas, the vessels are either so slightly developed as to escape comment,[1] or, under minute examination, they are not numerous.[2] In other examples a large number of small arteries inosculate on the interior of the osteo-fibrous capsule,[3] or the latter is lined by an extremely rich vascular network ;[4] or a plexus of capillaries, the walls of which have undergone sarcomatous degeneration, is present in the fibrous bands which intersect the tumour.[5] In these pulsating tumours, future and more accurate observations will, doubtless, disclose that their vessels are almost always enlarged, varicose, and brittle, and that their adventitia is the seat of small-celled infiltration, as in the case recorded by Labbé.

When they are once fully formed, giant-celled sarcomas exhibit a great proneness to undergo certain metamorphoses, some of which indicate progressive changes, or attempts to develop into the different varieties of mature connective tissue, while others represent retrogressive metamorphoses, due to impairment of the nutrition of their component elements. These secondary conditions of involution, and abortive efforts towards the formation of higher tissues, have led certain writers to constitute varieties of myeloid sarcoma, as the fatty, cystic, telangiectatic, hemorrhagic, fibrous, calcifying, ossifying, and chondroid, to which there can be no objection, provided these terms be merely employed as prefixes to indicate the nature of the changes that have ensued or designate the existence of certain subordinate tissues.

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[1] Billroth, Chirurgische Klinik, Wien, 1869–70, p. 367; Godlee, Trans. Path. Soc. London, vol. xxv. p. 202; Langston Parker, Med.-Chir. Trans., vol. xxxix. p. 138; Langenbeck, Langenbeck's Archiv., vol. xxi. Supp. p. 331, and Carville, Bull. Soc. Anat. de Paris, ser. 2, vol. xii. p. 475.

[2] Chassaignac, Nélaton, Obs. xxxv., and Lücke, Virchow's Archiv., vol xliv. p. 322.

[3] Robin, Nélaton, Obs. xxi.

[4] Sirus-Pirondi, Ibid., Obs. xxxvii.

[5] Labbé, Bull. de la Soc. Anat., 2d ser., vol. x. p. 230.

Of the retrograde changes, by far the most constant and important is fatty degeneration, which manifests itself by the presence of minute granules of fat and drops of oil in the cells, through which they are rendered obscure, and finally converted into granular corpuscles, which disintegrate and disseminate their contents into the intercellular substance. To this change may be ascribed the softness and the creamy, light buff, yellowish-white, amber, or orange-yellow tints of the morbid mass; and to it, in connection with deficient vascular supply, may be referred the yellowish friable nodules which are occasionally scattered through the neoplasm, and which represent the cheesy form of fatty metamorphosis. As still further consequences of fatty changes, the granular corpuscles liquefy and form retention cysts, and hemorrhage is liable to occur from implication of the capillary vessels.

One of the most striking peculiarities of these tumours is the formation of cysts or cystoid spaces, both simple and multilocular, which vary in size from a millet-seed to a fist, and are occupied by fluid, semifluid, or clotted blood, fatty emulsion, or sanguinolent, or clear serous fluid. Their number may be so great as to have replaced almost entirely the original texture, so that the specimen under inspection conveys the impression of being one of cystic disease of the bone. It is to this form of giant-celled sarcoma that Mr. Henry Gray[1] applied the name myelocystic tumour. They are not, however, true cysts, lined by a secreting membrane, but rather irregular spaces or cavities, the walls of which are composed of fibrillated tissue studded with granular fat and drops of oil, and presenting more or less distinct traces of degenerated giant cells, and occasionally stained of a deep orange colour by crystals of hæmatoidin. Their origin is distinctly due either to disintegration and liquefaction, or mucoid softening, of the elements which have undergone fatty metamorphosis, or to extravasations of blood in the softened fatty areas from rupture of the enlarged and degenerated vessels. In the former event, the softening cysts contain turbid, opaque, buff-coloured fluid, or a straw-coloured serosity; while, in the latter mode of formation, the extravasation cysts are filled with blood or coagula, or, in the event of the absorption of the solid constituents of the blood, with a sanguinolent fluid.[2]

In connection with extravasation cysts, reference may again be made to the vascularity of these tumours. That newly-formed vessels are sometimes present in enormous numbers, and are much dilated, and that they easily rupture and give rise to considerable interstitial bleedings, is shown by the foregoing considerations, and by the fact that not a few of these tumours have been confounded with aneurism, whence their various names telangiectatic and hemorrhagic sarcoma,[1] hematoma, fungus hematodes, and aneurism of bones. In the majority of the ten examples of giant-celled sarcoma, previously alluded to, in which the pulsation was due to inherent changes and not to overlying arteries, the mass of the tumour was converted into cysts filled with blood in various stages of consistence, but principally in the form of black clots or a syrupy fluid. In the case of Lücke, however, in which, in addition to expansile pulsation, there was a short systolic murmur that disappeared on compression of the femoral artery, through which the volume of the tumour was also diminished, there were no cysts, the material of which the growth was composed being soft, smooth, and marked with clear red spots, and fed by a moderate number of large vessels. From these reflections, and from the fact that the earlier recorded cases of aneurism of bone consisted of a large sac filled with fluid or clotted blood, I am disposed to believe with Nélaton,[2] Volkmann,[3] and Lücke,[4] that the vast majority of so-called aneurisms of bone are nothing more than pulsating giant-celled sarcomas, if not with Virchow,[5] Landi,[6] and Broca,[7] that such an affection does not exist.

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[1] Med. Chir. Trans., vol. xxxix. p. 121.

[2] The mode of formation of these cysts has been carefully studied by Dr. Bristowe, Trans. Path. Soc. Lond., vol. vii. p. 370.

In the firmer forms of tumour, or in fibrous myeloid sarcomas, it is not uncommon to meet with irregular masses of a dense, translucent, grayish-white, glistening character, which are made up of large fusiform elements or of interlacing bands of fibrous tissue. In other examples, the appearances are very similar to those presented by a section of the spleen, fibrous trabeculæ being given off from the inner surface of the capsule, which, by their union, constitute an areolar framework, in the interstices of which the brownish-red characteristic material of the growth is contained.

Calcification and ossification of giant-celled sarcomas are far less frequent than in peripheral sarcomas, being present in only twenty per cent. of all cases; but these changes are singularly interesting from the fact, as I shall have occasion to show, of their occurring in the majority of the growths which present malignant features, and which, on that account, are very analogous to the ossifying periosteal sarcomas of the shafts of the long bones. Respecting these changes, it is only necessary to say that calcification is far more common than ossification, true bone being rarely encountered, while the deposition of the earthy salts in the intercellular substance, and to a less extent in the cells, is the rule. In sections of tumours undergoing these changes, numerous rough or sharp points can be both seen and felt, and minute examination usually discloses opaque, black, roundish molecules irregularly interspersed through the soft tissue, or forming a network in which the cellular elements are contained. In some specimens bony spicules penetrate the tumour in every direction, and even supply in part the place of the original bone. Thus, in the case of Lawrence,[1] the tibia, which had disappeared for five or six inches, was substituted by a framework of osseous fibres and plates, which traversed the bony sac in all directions, and connected the articular cartilage of the tibia with the lower portion of that bone. In other examples, osseous plates are inclosed in fibrous bands, and the walls of the cysts may even be partially ossified. Again, isolated fragments of what is apparently spongy bone are scattered throughout the tumour, or one-half of the growth may be composed of a dense calcareous mass, while the other half is sarcomatous. Finally, as in the case of Berend,[2] the neoplasm may be constituted by a series of nodosities or lobes, each of which is surrounded by a more or less perfect osseous capsule containing a red tissue.

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[1] Virchow, op. cit., p. 190.

[2] Op. cit., p. 230.

[3] Pitha and Billroth's Handbuch der Allg. und Spec. Chirurgie, Bd. 2, Abth. 2, Lief. 1, p. 477.

[4] Ibid., Bd. 2, Abth. I. Heft 2, p. 200.

[5] Op. cit., vol. iv. p. 68, French translation.

[6] Amer. Journ. Med. Sciences, January, 1878, p. 278.

[7] Traité des Tumeurs, vol. ii. p. 212, 1869.

The occurrence of cartilage in myeloid sarcomas is relatively infrequent; but this combination has been observed by Gray,[3] Paget,[4] Meckel,[5] and others, in the form of small plates, although rarely in sufficient quantity to justify the prefix chondroid.

Inflammation of these growths may be ranked among pathological curiosities. Mr. Little[6] has recorded a case in which an abscess opened over the outer condyle, and was found, after amputation, to communicate with a cavity, partially filled with pus, in the interior of the mass. In a case, occurring in the practice of Langenbeck,[7] there was a fistulous opening in the reddened skin, through which a probe could be passed into the tumour, which occupied the lower end of the radius.

Giant-celled sarcomas of the long bones are most frequent in the lower extremity, and they are almost exclusively confined to the epiphyses. Thus, of 70 recorded examples, the seat of the tumour was in the

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[1] Med.-Chir. Trans., vol. xvii. p. 35, and vol. xxxix. p. 133.

[2] Virchow, op. cit., p. 323.

[3] Op. cit., p. 138.

[4] Op. cit., 3d ed. p. 528.

[5] Charité-Annalen, vii. p. 93, 1856.

[6] Trans. Path. Soc. Lond., vol. xiv. p. 245.

[7] Langenbeck's Archiv, vol. i. p. 143, case 2.

Tibia,	upper epiphysis, in	21	cases, lower epiphysis, in	2	cases
Femur,	" " "	2	" " " "	17	"
Fibula,	" " "	7	" " " "	2	"
Humerus,	" " "	5	" " " "	1	"
Radius,			" "	5	"
Ulna,	" " "	1	" " " "	3	"
Femur,[1] shaft		2	Humerus,[2] shaft	1	
Radius,[3] shaft 1.					

These localities show that the medulla of the spongy substance of the articular extremities, and not the medulla of the diaphyses, is the favourite tissue for their development.

They are only slightly more common in men than in women. Of 63 cases, in which the sex is known, 33 occurred in males, and 30 in females.

They do not appear to be inherited; are not met with during infancy and childhood; are not very common during adolescence; their greatest frequency is during the age of maturity, or from 21 to 40 years; while their occurrence is rare during middle and old age. The age at which the affection was first noticed is given in 60 cases, the youngest being 14,[4] and the oldest years 68,[5] the sum of the ages equalling 1694 years, making the mean age of its appearance 28.2. These facts are set forth in the following table:—

Age.	No. of Cases.
10 to 20	14
20 " 30	26
30 " 40	12
40 " 50	3
50 " 60	4
60 " 70	1
	60

Thirty-one subjects recognized previous injury or disease as the exciting causes of the affection. In six instances it was ascribed to blows, in fifteen to falls, in three to sprains, in one to luxation and fracture, in one to fracture alone, in one to a strain in throwing a stone, in one to a kick, and in three to rheumatism. In the majority of these cases the influence of the injury upon the development of the neoplasm is unmistakable. The general health of the subjects was, with few exceptions, good.

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[1] Bryant, Trans. Path. Soc., Lond., vol. viii. p. 387, in a lad, æt. 15; the epiphysis was not yet united to the shaft; Peulevé, Bull. Soc. Anat., 2d ser., vol. x. p. 658, in a woman of 54.

[2] Bristowe, Trans. Path. Soc., Lond., vol. vii. p. 351, in a boy, æt. 18; the shaft and upper epiphysis not yet united.

[3] Bryant, The Practice of Surgery, Phila. 1879, p. 873.

[4] Cadiat, Bull. Soc. Anat., ser. 3, vol. viii. p. 372.

[5] As the occurrence of this growth after the 39th year is interesting, the following references and ages are considered worthy of record. Thompson, Trans. Path. Soc., vol. x. p. 237, at 68; Brown, see p. 27 of this paper, at 57; Carville, Bull. Soc. Anat., ser. 2, vol xii. p. 475, at 55; Peulevé, Ibid. ser. 2, vol. x. p. 658, at 54; Fergusson, Trans. Path. Soc., vol. xx. p. 278, at 51; Henry, Ibid. vol. ix. p. 367, at 41; Hulke, Archives of Medicine, vol. i. p. 110, at 41; and Langenbeck, Langenbeck's Archiv, vol. i. p. 143, case 2, at 40.

Myeloid sarcomas, as a rule, grow more slowly than the other varieties of sarcoma of the long bones, although when they are compared with each other, some are observed to attain a large size in a comparatively short period. For purposes of comparing the rate of increase, tumours occupying the same situation may be selected. Thus, in the head of the humerus, the growth may be as large as two fists in twelve months, or as a child's head in five years, or have a circumference of twenty-eight inches in thirty months, or of thirty-two inches in ten years; in the lower epiphysis of the femur it may acquire a circumference of twenty inches in two years, or a circumference of twenty-six inches in six years; in the lower end of the radius, a diameter of two inches and a half in six months, or a diameter of five inches in ten years. In the last example, the tumour which attained a diameter of two inches and a half was growing ten times more rapidly than the one which was ten years in reaching a diameter of five inches. In the largest tumours both extravasation and exudation cysts are generally met with; but neither the rate of growth nor the volume depends upon these retrograde changes, as might naturally be expected, since it is in just these cases of rapid growth that the texture of the tumour is firm and typical. Certain conditions do, however, favour their increase. Among these are injuries, such as blows, or falls, or even exploratory punctures, or friction with liniments, pregnancy and nursing, of which latter states examples are furnished by Lawrence[1] and Langenbeck.[2]

Their growth is progressive or continuous, but in about six per cent. of all cases, it is temporarily arrested. Of this occurrence, the most noteworthy example is recorded by Mr. Hutchinson,[3] in which a tumour of the head of the humerus, after having acquired about two-thirds of the volume of an infant's head in fourteen months, ceased to grow for four years, when, without obvious cause, it renewed its activity.

During their entire progress, giant-celled sarcomas generally exhibit no tendency to break through their limiting capsules, hence their influence on the surrounding tissues is almost purely mechanical, the overlying and associated structures being, as previously indicated, stretched and attenuated, and not incorporated with the tumour, or implicated by extension of the disease. The skin almost invariably preserves its mobility and natural tint; the subcutaneous veins are usually not enlarged; the muscles, tendons, ligaments, and other soft structures are extended, and, perhaps, displaced; the contiguous bones, as, for example, the fibula when the tibia is affected, are occasionally bent, or slightly eroded, or even absorbed;[1] the joints are commonly not implicated, and the medulla of the shafts of the bones which terminate in the tumour, and the lymphatic glands and distant organs are, as a rule, free from secondary or metastatic deposits.

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[1] Med. Chir. Trans., vol. xvii. p. 35

[2] Langenbeck's Archiv, vol. xx. sup. pp. 329-331.

[3] Trans. Path. Soc., Lond., vol. viii. p. 346.

To these general statements there are exceptions, some of which are notable.

α. The skin is usually discoloured, thin, glossy, and tense, now and then thickened by hyperplastic processes, and not by infiltration with the elements of the tumour, but very rarely adherent or ulcerated, unless as the result of traumatism or exploratory puncture. The subcutaneous veins, which, as a rule, are not enlarged, are greatly dilated in twenty-seven per cent. of all cases.

β. The fibres of the adjacent muscles are liable to become adherent to the mass and to be the seat of fatty, fibroid, and possibly hyaline changes. Occasionally, but particularly when the investing capsule of the growth has been perforated, the fasciculi are separated by nodules of sarcomatous tissue,[2] and, in a case of Cohnheim,[3] at the point of contact of the tubers, were zones of a bright red colour, which consisted not only of round and fusiform cells, but also of very numerous and exquisitely developed giant cells, which were, moreover, detected in the intermuscular connective tissue at a distance of four millimetres from the tubers. This is the best example of local infection on record. In the case of Bristowe,[4] the intermuscular veins of the deltoid were enlarged and distended by a pulpy tissue, which presented the same minute characters as the tumour itself.

γ. The contiguous bones show little proneness to invasion, the only examples of this occurrence that I have discovered being the following:—

A farmer, aged 36 years, presented himself at the clinic of the Jefferson Medical College, June 16th, 1876, on account of a huge tumour of the left humerus, of an elongated globular shape, elastic at points, and the seat of parchment crackling at others, but generally hard from the presence of a dense bony capsule. Its greatest circumference was twenty-eight inches, against eleven inches at the corresponding point of the sound limb, and it extended from two inches above the condyles to two inches above the level of the shoulder. The skin was tightly stretched over the mass, but it was mobile and free from discoloration; and a few of the subcutaneous veins were enlarged. The neighbouring lymphatic glands were sound, and the general health was excellent. Attention was first called to the trouble twenty-nine months previous to his admission, by fracture of the humerus two inches below the joint, which was at once followed by the appearance of the tumour. On disarticulation at the shoulder, by Professor Gross, the upper portion of the axillary border of the scapula had to be extensively gouged away, and the origins of the muscles cut off, in consequence of their involvement by the material of the new growth.

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[1] Bennett, Dublin Journ. Med. Sci., Sept. 1, 1877, p. 427.

[2] Langenbeck's Archiv, vol. i. p. 141, case 5.

[3] Virchow's Archiv, vol. xl. p. 286.

[4] Trans. Path. Soc., Lond., vol. vii. p. 354.

In the case of Berend, recorded by Virchow,[1] the disease was propagated from the head of the fibula to the head of the tibia; and in that of Langenbeck,[2] a nodule was discovered in the spongy tissue of the humerus, after total resection of the elbow-joint for a giant-celled sarcoma of the upper extremity of the ulna.

δ. Notwithstanding the fact that the shaft of the bone usually terminates abruptly in the tumour, its exposed medulla is singularly free from implication, thereby forming a striking contrast with the deposits in the marrow found in connection with periosteal sarcomas. Among the few instances of infiltration of the medulla, that recorded by Sir Benjamin Brodie, and examined by Mr. Gray,[3] is worthy of mention.

ε. The adjacent articulation occasionally undergoes destructive changes from nutritive disturbances, as has been witnessed by Carville,[4] Ledentu,[5] and Langenbeck;[6] but the investing cartilages of the epiphyses appear almost constantly to oppose a barrier to encroachment on the joint, although they are much thinned and form part of the capsule. That they may, in opposition to the earlier statements on this point, be perforated, is attested by at least two examples. Thus, in the case of Sir Benjamin Brodie,[7] "the articular surface of the condyles had been entirely absorbed, and the morbid growth had made its way into the cavity of the knee-joint, which it distended throughout, pushing the patella and its ligament forward, absorbing the cartilaginous surface of that bone, and making its way into the cancellous tissue. The cartilage covering the head of the tibia had the growth adhering to it in some parts, whilst in others the cartilage had been absorbed, and the morbid structure had made its way into the cancellous tissue of this bone, but only to a very slight extent." In the case recorded by Mr. Moseley,[8] the cartilage was "perforated, but the joint was but slightly affected."

In the majority of examples of implication of the neighbouring joint, however, the cartilage of incrustation remains whole. In the case of Dr. L. A. Stimson,[9] of New York, the tumour had "broken through the intercondyloid notch, and sent a bony column, half an inch in diameter, between the crucial ligaments, down to the anterior edge of the articular surface of the tibia." The capsule of the joint was also perforated, and the neoplasm surrounded the patella and eroded its anterior surface. In the remarkable instance of calcifying giant-celled sarcoma of the head of the tibia, reported by Mr. Butlin,[1] the crucial ligaments were converted into a firm calcified mass, and the disease was propagated through them into the lower portion of the femur, which, however, was only slightly affected. In the remaining instances of invasion of the joints the reports are as follows: "In the notch between the condyles, the tumour formed one or two gelatinous prominences into the joint behind the synovial membrane."[2] Projecting into the knee-joint from the internal condyle, and covered only with the thinnest film of articular cartilage, was a bluish growth, looking like a venous nævus;[3] and "the synovial cavity was also entirely occupied by the growth which filled the space between the articulating surfaces of the femur and tibia."[4]

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[1] Op. cit., pp. 323 and 337.
[2] Langenbeck's Archiv, vol. xxi. sup. p. 329.
[3] Med. Chir. Trans., vol. xxxix. p. 128.
[4] Bull. Soc. Anat., 2d ser., vol. xii. p. 475.
[5] Ibid., 2d ser., vol. ix. p. 515.
[6] Langenbeck's Archiv, vol. xxi. sup. p. 329.
[7] Med. Chir. Trans., vol. xxxix. p. 131.
[8] Trans. Path. Soc., Lond., vol. xx. p. 281.
[9] The Medical Record, Jan. 6th, 1877, p. 11.

The above seven examples demonstrate that a more extended examination does not confirm the positive assertion of Mr. Erichsen,[5] who says: "It is a remarkable fact, long ago pointed out by Petit, and more recently insisted on by Richet, and which I have often had occasion to verify, that, although the epiphysis may have been completely degenerated, the cartilage of incrustation and the neighbouring joint never becomes implicated."

ζ. Of extreme interest, from a pathological as well as a practical point of view, is the condition of the lymphatic glands directly connected with the tumour, which are stated to have been hypertrophied in only eight instances. In two, in which further histories are wanting, and in which the structure of the glands appears to have escaped notice, these organs were involved; in the first,[6] one gland in the groin was hypertrophied, and, in the second,[7] both groins were affected, but to a greater extent on the side corresponding to the tumour, the gland being of "the size of a crown-piece and spongy to the touch." In six examples the glands were merely enlarged from irritation. In that recorded by Dr. E. H. Bennett,[8] a gland over the saphenous opening diminished at least one-third after amputation, from which the patient recovered. On dissection of the limb, some enlarged glands were discovered in the popliteal space, which were found to contain only normal elements. In the case described by Mr. Godlee,[9] which also recovered, one or two glands in the groin were decidedly smaller two months after amputation. In the instance of Mr. Little,[10] the glands in the groin subsided after amputation, and recovery followed. The popliteal glands, which were found to be hypertrophied on inspection of the limb, were simply hyperplastic. In the case of Chassaignac,[1] the enlarged glands in the groin gradually diminished after amputation, and the man was alive four years subsequently. In the case of Mr. Hutchinson,[2] which, as will be presently seen, was remarkable for being an instance of local return and general infection, the infraäxillary glands formed a mass as large as the fist; but they were merely loosely connected with each other and with the surrounding tissues, and only showed "microscopical indications of hypertrophy and inflammatory conditions." Finally, in the case of Mr. Butlin,[3] the enlarged and tender femoral glands had subsided to nearly their normal size one month after successful operation. The absence of sarcomatous elements from the glands submitted to minute inspection; their diminution or disappearance after operation; the non-occurrence of periadenitis, through which they remain isolable and unattached to the connective tissue in which they are imbedded; their freedom from ulceration, and their non-involvement in four other examples of general dissemination of the disease, are facts that lead to the conclusions that, in giant-celled sarcoma, glandular enlargement is the effect of irritation and not of specific infiltration, and that systemic infection takes place through the vascular, and not through the lymphatic, system.

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[1] St. Bartholomew's Hosp. Rep's, vol. x. p. 121. Mr. Butlin records this case as being one of round-celled sarcoma; but the slow progress of the disease, and the minute examination, which showed it to be "for the most part round-celled, but containing not a few myeloid cells," have led me to include it among the giant-celled growths.

[2] Godlee, Trans. Path. Soc., Lond., vol. xx. p. 202.

[3] Hulke, ante.

[4] Sydney Jones, Trans. Path. Soc., Lond., vol. x. p. 246.

[5] The Science and Art of Surgery, Phila. 1878, vol. ii. p. 208.

[6] Brichetau, Bull. Soc. Anat., 2d ser., vol. 3, p. 470.

[7] Moseley, ante.

[8] Ante.

[9] Ante.

[10] Ante.

Like the other varieties of sarcoma of the long bones, myeloid tumours are, therefore, occasionally locally infectious, as is evinced by the invasion of their own osseous capsules,[4] the contiguous bones and joints, and the surrounding soft tissues.

η. Giant-celled sarcomas, as a rule, are confined to the parts in which they originate and grow; but they sometimes recur after removal, and even exhibit more marked signs of malignity, by forming metastatic or secondary tumours in distant organs. As Nélaton, Gray, and other writers are disposed to regard them as being habitually of a benign character, I shall offer no apology for giving abstracts of the recorded cases of generalization, from which it will be observed that no doubt can be entertained of their not very infrequent malignant nature.

CASE I. Dr. Stimson[5] amputated the thigh of a man, aged 37 years, on the 31st of November, 1876, on account of myeloid sarcoma of the lower epiphysis of the femur, of ten months' standing. The tumour, which had invaded the knee-joint, was composed of round and fusiform cells, and "of large quantities of myeloplaxes, especially near the points of ossification." In about eight weeks, the patient began to cough and spit blood, and some weeks subsequently a hard, flat tumour appeared on the left frontal bone.

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[1] Nélaton, op. cit., Obs. xxxvi. and Gazette des Hôpitaux, 1863, p. 25.

[2] Trans. Path. Soc., Lond., viii. pp. 351 and 355.

[3] Ante.

[4] Vide page 27, and Trans. Path. Soc., London, vol. vii. p. 362.

[5] The Medical Record, vol. xii. 1877, pp. 11 and 524.

Death ensued on May 4, 1877, or five months and a half after the operation, when the lungs were found to be filled with nodules, varying in size from a cherry to a child's fist, which were composed of round and fusiform cells. In a few there were calcareous deposits; while a piece of fully-formed bone, an inch in diameter and one-third of an inch thick, was found in the largest nodule. The frontal bone was occupied by an ossifying sarcoma;[1] and three ossifying minute red growths were seated on the under surface of the dura mater where it was adherent to the frontal tumour, which were made up of similar elements. The lymphatic glands, the remaining viscera, and the stump were free from disease.

Case II.[2] A labourer, 30 years of age, underwent amputation of the thigh, Oct. 7, 1856, for a typical giant-celled sarcoma of the head of the fibula, of seven months' duration. In two years, or on Oct. 20, 1858, he returned to the hospital with a tumour, as large as the closed fist, on the inner side of the thigh, and two smaller ones on the outer side, all of which, were found to consist of myeloid tissue, contained in thick, and partly bony, capsules, which were not connected with the femur. On death from acute pleurisy, Nov. 26, Dr. Wilks found three or four pendulous giant-celled tumours, one of which was as large as the heart, growing from the surface of each lung, and looking like supernumerary lobes. The lymphatic glands, and all of the other organs were healthy.

Case III.[3] A rheumatic woman, aged 43 years, had suffered for twelve months from pains in the right shoulder, which, in six months, became laminating and excessively severe. About two months before admission into the hospital, under the care of Mr. Mitchell Henry, she first noticed a swelling, which at length produced such extreme suffering as to demand disarticulation, on the 10th of September, 1857. Much of the tumour, which was as large as an orange, was composed partly of dense osseous tissue, and partly of firm fibroid material, and was continuous with a soft, reddish substance which occupied the medullary cavity of the head of the humerus. The external parts of the growth were made up of fibroplastic tissue and a few myeloid cells, while the internal red portion was composed almost entirely of giant cells. When she was discharged at the end of five or six weeks, there was some suspicious tumefaction about the shoulder; and on her return, on the 16th of November, or in eleven weeks after the operation, her health was entirely broken down, and there was an ulcerated tumour of the stump, which increased, until it attained the size of a fœtal head, and was the seat of excessive pain and a profuse, fetid discharge.

After death, on the 16th of December, dissection disclosed a mass growing from the neck of the scapula, and including the axillary glands, which, however "could not be made out distinctly," which was composed of calcified bosses, divided by fibrous septa and loose clots of blood, and of softer tissue. The latter was made up of small nuclei and oval and fusiform cells in a finely granular gelatinous matrix, and numerous giant elements were present in nearly every part of the tumour. In each lung were from twenty to thirty superficial nodules, which varied in size from a pin's head to a pea, and were composed of calcifying small-celled tissue, in which giant cells were not abundant. The other viscera were normal as regards secondary deposits.

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[1] Virchow (op. cit., vol. ii. p. 321) states that he has never seen an osteoid metastatic tumour in a bone.

[2] Guy's Hosp. Reps., ser. 3, p. 174, and Trans. Path. Soc., Lond., vol. ix. p. 244.

[3] Trans. Path. Soc., Lond., vol. ix. p. 367.

Case IV.—Mr. J. Cooper Forster[1] has recorded the case of a boy of 18 years, in whom, on the 18th of May, 1857, Mr. Cock amputated through the thigh for a myeloid tumour of the head of the fibula, of about five months and a half standing. Masses of bone were interspersed through an encephaloid tissue, " but here and there were portions which presented cells of a true myeloid character," or, as Dr. Wilks,[2] who describes the sequel, under the title of a " Case of Osteoid Cancer combined with Myeloid Disease," states, the soft white material was composed of a " mass of nucleated cells; interspersed with these, however, were numerous polynucleated cells with branching processes, such as are styled myeloid." At the end of August the patient had become paraplegic, and death ensued on the 16th of October. There was no return of the disease in the stump; and all the organs, excepting the lungs and spine, were healthy. Each of the former contained about twenty red, vascular nodules, of which the largest were of the size of a marble. They were composed of calcareous granules, and of cells similar to those found in the original tumour. The lower dorsal vertebræ were infiltrated with the same histological elements; their bodies were destroyed posteriorly, the theca of the cord was surrounded by the new material, and the medulla was disorganized.

Case V.—Mr. Hutchinson[3] removed, on the 14th of May, 1856, the upper third of the humerus, along with the acromion and coracoid processes, and a mass of enlarged glands, of a woman 33 years of age, on account of a tumour of the size of an infant's head, of four years and ten months' duration, which contained deposits of soft spongy bone, and was composed of fibroplastic cells and many large polynucleated cells, the former of which predominated. In three weeks an enlarged gland was detected in the posterior triangle of the neck; in ten weeks the main wound had closed, but about this time a fungus appeared at the unhealed wound left by the removal of the infraäxillary glands, and the upper divided end of the humerus became tumid. The disease continued to progress in each of the three different situations; the cicatrices of the incisions gave way, a large fungus projected, and the woman finally died, about five months after the operation, from the effects of repeated hemorrhages from the lower fungus.

The recurrent growths of the axilla and of the periosteum of the shaft of the humerus, at the point of section, " exuded most plentifully a white cream-like juice, which abounded in free nuclei, and contained some large cells, having from one to three nuclei." In the right lung were several deposits of infiltrated soft "cancer" resembling the growth in the axilla.

In all of these cases it is interesting to observe that the lungs were the seat of secondary tumours, so that, in this regard, the likeness between myeloid and peripheral sarcomas is complete. In four instances the bones, or their investing membrane, were also affected; but, with the exception of the dura mater, no other tissues or organs were involved.

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[1] Trans. Path. Soc., Lond., vol. viii. p. 389.

[2] Ibid., vol. ix. p. 377.

[3] Ibid., vol. viii. p. 346.

These illustrations of the malignity of giant-celled sarcoma demonstrate conclusively that the idea of their absolutely innocent character must be abandoned. The explanation given by certain observers, as, for example, Nélaton,[1] Wilks,[2] and Forster,[3] that malignity is witnessed only in the "mixed" forms, is not tenable, since, as was demonstrated by Virchow,[4] giant cells are not the only elements found in these tumours, fusiform and round elements always being present in varying quantities, through which this variety of central sarcomas is, in reality, a "mixed" growth. Indeed, as Virchow states, the same objection might just as well be urged against the majority of cases which recovered after operation. Nor will it do, with Hutchinson,[5] to regard the original tumour as being of a myeloid nature, and the secondary deposits as cancerous, since at the time this case was recorded the nature of morbid growths was determined by the presence of so-called cancer cells in the juice, and not from properly prepared sections.

There is a point, however, in connection with the histological construction of these malignant giant-celled sarcomas, with which I have been particularly struck, namely, the presence of granules or masses of calcareous matter or of true bone in their interior, through which they have a close likeness to the periosteal osteoid or ossifying sarcomas, which are excessively malignant. In all of the foregoing instances, except Case II., these elements were found, and it is quite possible that bone was overlooked in that example, since the recurrent growths in the stump were surrounded by capsules which were in part osseous, although that tissue seems to have been absent from the secondary deposits in the lungs. In Case I., the mass was pervaded by numerous points of ossification, and its lower portion was occupied by a piece of bone, from which a column was extended, between the crucial ligaments, to the tibia. The metastatic nodules in the lungs contained calcareous points, and a piece of fully formed bone was found in the largest nodule. The tumour of the frontal bone was ossifying, and those of the dura mater were calcifying. In Case III., the primary tumour was partly composed of dense osseous tissue, while the recurrent growth of the scapula was made up of calcified bosses, and the nodules in the lungs were calcifying. In Case IV., masses of bone were interspersed through the tissue of the original growth, and the secondary deposits in the lungs and vertebræ were the seat of calcareous granules. Finally, in Case V., deposits of soft spongy bone existed in several parts of the original tumour; but the recurrent and secondary growths, the examination of which, however, was certainly not thorough, were free from calcareous or ossific changes.

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[1] Op. cit., p. 332.

[2] Lectures on Pathological Anatomy, Edited by Moxon, p. 59.

[3] Loc. cit. [4] Op. cit., p. 336. [5] Loc. cit., p. 352.

When it is remembered that calcifying and ossifying periosteal sarcomas are almost as malignant as the periosteal sarcomas which are not characterized by these degenerations; and that the secondary deposits, which are also most frequent in the lungs, are also the seat of similar changes, not only is the analogy between malignant central and peripheral sarcomas very striking, but one is tempted to ask, "Is not generalization, in some cases at least, due to these metamorphoses?"

In the solution of this question, it is necessary to determine, in the first place, whether the osteoid myeloid sarcomas are really more malignant than those in which calcareous or ossific changes are not observed; and, secondly, whether the mineral salts may not act as the carriers or transporters of the infecting material.

1. Out of 51 cases, of which I have full histories, 3 died without operation, and 48 underwent amputation or excision.[1] Of the latter, 15 died from the effects of surgical interference, and 33 recovered, but of these 5, that is to say, the cases above recorded, terminated fatally from general dissemination of the disease, at periods which varied from three months to two years, the average being eight months. Excluding 11 cases, in none of which does the history extend beyond two months after the operation, and, using for the purposes of comparison only those which remained well for periods which extended over three months and upwards, we have 22 cases, of which 5, or 22.72 per cent., died with recurrence of the disease, and 17 recovered. For convenience of reference, all of the recoveries are appended in the subjoined table, the cases used in the above comparison terminating with that of Mr. Morris, or No. 17.

With regard now to the degree of malignity of the osteoid, that is to say, the calcifying and ossifying varieties of myeloid sarcoma, the descriptions state that these metamorphoses were present in 7 of the 22 recoveries from operation. Of these, as I have pointed out, the four cases of Stimson, Henry, Forster, and Hutchinson, subsequently succumbed from generalization, while in 3 the deposits did not exert any influence upon the duration of life, since in Larrey's case the patient was alive six years and a half after the operation, and the disease had existed ten years before amputation was resorted to; while in the case of Bristowe, the man died of pulmonary phthisis five years after disarticulation at the shoulder, and in the case of Paget, the woman survived amputation of the thigh for "many years." These cases are numbered 8, 12, and 13 in the table. Of the remaining 15 examples in which the texture of the tumour was free from the mineral salts, only one, that of Wilks, died, and in this case six or eight large metastatic tumours were discovered in the lungs.

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[1] Ten additional cases were subjected to amputation; but as they were recorded immediately after operation, and I could not trace their further histories, they were only used in the study of the general pathology of giant-celled sarcomas.

Table of Recoveries after Operations for Giant-celled Sarcoma.

Case.	Sex.	Age.	Seat.	Duration.	Operation.	Later history.	Total duration of life from first notice of disease.	Operator and recorder.	Reference.
1	F.	18	Upper humerus	?	Disarticulation	No return in 2 yrs.	?	Brodie and Gray	Med. Chir. Trans., vol. xxxix. p. 127.
2	M.	25	Lower femur	18 mos.	Amp. thigh	“ “ 5 “	6 yrs. 8 mos.	“ “ “	“ “ “ “ p. 129.
3	M.	36	“ “	6 yrs.	“ “	“ “ 10 “	16 years	“ “ “	“ “ “ “ p. 131.
4	M.	19	Lower fibula	12 mos.	“ leg	“ “ 4 “	5 years	Parker and Gray	“ “ “ “ p. 137.
5	F.	21	Lower femur	14 mos.	“ thigh	“ “ 5⅔ “	6 yrs. 8 mos.	Velpeau and Nélaton	Op. cit., vol. xxx., and Gaz. des Hôp., 1863, p. 25.
6	F.	29	Upper tibia	12 mos.	“ “	“ “ 4 “	5 years	Chassaignac and Nélaton	Op. cit., Obs. xxxv., and Gaz. des. Hôp., 1863, p. 25.
7	M.	29	Lower femur	10 mos.	“ “	“ “ 4 “	4 yrs. 10 mos.	Chassaignac and Nélaton	Op. cit., Obs. xxxvi., and Gaz. des. Hôp., 1863, p. 25.
8	M.	37	Lower radius	10 yrs.	“ forearm	“ “ 6¼ “	16¼ years	Larrey and Nélaton	Op. cit., Obs. xliv., and Gaz. des Hôp., 1863, p. 25.
9	M.	26	Lower femur	28 mos.	“ thigh	“ “ 3 y. 5 m.	5 yrs. 9 mos.	Billroth	Chir. Klinik, Zurich: 1860–67, p. 569.
10	F.	40	Lower radius	?	“ forearm	“ “ 6 yrs.	?	Langenbeck and Senftleben	Langenbeck's Archiv, vol. i. p. 143
11	F.	30	Lower ulna	?	Resec. ¾ ulna	“ “ 4 “	?	“ “	“ “ “ “
12	M.	18	Upper ½ shaft humerus	6 mos.	Disarticulation	“ “ 5 “	5½ years	Simon and Bristowe	Trans. Path. Soc. Lond., vol. vii. p. 351, and vol. x. p. 247.
13	F.	24	Upper tibia	10 mos.	Amp. thigh	“ “ many y.	?	Paget	Lect. on Surg. Path., 3d ed., 1870. p. 547.
14	M.	25	Lower femur	2 yrs.	“ “	“ “ 2 yrs.	4 years	Cock and Wilks	Guy's Hosp. Rep., 3d ser.. vol. iii. p. 168, Case I.
15	F.	24	Upper tibia	6 mos.	“ “	“ “ 15 “	15¼ years	Bryant	Guy's Hosp. Rep., 3d ser., vol. xxii., p. 314.
16	F.	29	Lower ulna	10 mos.	Excision lower ¼	“ “ 8 “	18 months	Lucas	British Med. Jour., April 28, 1877, p. 515.
17	F.	?	Lower radius	10 mos.	“ both bones	“ “ 10 “	20 months	Morris	“ “ “ “ “ “
18	M.	18	Lower femur	4 mos.	Amp. thigh	“ “ 2 mos.	6 months	Hill and Godlee	Trans. Path. Soc. Lond , vol. xxv. p. 202.
19	F.	30	Upper tibia	18 mos.	“ “	“ “ 40 days	19⅓ months	Lawrence and Gray	Med. Chir. Trans., vol. xvii. p. 135, and vol. xxxix. p. 133.
20	M.	43	Lower femur	18 mos.	“ “	“ “ 1 mo.	19 months	Fergusson and Hulke	Archives of Medicine, vol. i., p. 110.
21	F.	33	“ “	12 mos.	“ “	“ “ 7 wks.	14 months	Cock and Wilks	Guy's Hosp. Rep., ser. 3, vol. iii., p. 169.
22	M.	31	Upper tibia	15 mos.	“ “	Recovered	16 months(?)	Marshall and Beck	Trans. Path. Soc. Lond., vol. xxii. p. 210.
23	M.	20	Lower tibia	12¼ mos.	“ “	Recovered	13⅓ months(?)	Hilton and Moseley	“ “ “ “ vol. xx. p. 279.
24	F.	22	Upper ulna	6 yrs.	Resection elbow joint	No return in 2 mos.	6 yrs. 2 mos.	Langenbeck	Langenbeck's Archiv, vol. xxi., supp. p. 329.
25	F.	26	Upper fibula	15 mos.	Excision ½ fibula	“ “ 8 wks.	17 mos.	“	Langenbeck's Archiv, vol. xxi., supp. p. 333.
26	M.	37	“ “	12 mos.	Amp. thigh	Recovered	13 months (?)	Bennett	Dub. Jour. Med. Sci., Sept. 1, 1877, p. 247.
27	M.	27	Lower femur	2 yrs.	“ “	Recovered	2 yrs. 1 mo. (?)	Little	Trans. Path. Soc. Lond., vol. xiv. p. 245.
28	M.	16	Upper tibia	2 yrs. 9 mos.	“ “	Recovered	2 yrs. 10 mos.	Butlin and Savory	St. Bartholomew's Hosp. Rep., vol. x. p. 120.

From the foregoing considerations it will be seen that 22.72 per cent. of all cases of myeloid tumours are malignant, and that the degree of malignity may be graded in accordance with the existence or absence of calcareous or osseous deposits, since these were found in the original tumour in four of the five cases of metastasis. Further, it will be observed that the osteoid myeloid tumours are not absolutely malignant, as 42.85 per cent., or 3 out of 7, patients remained well several years after their removal. Finally, in this connection, it may be stated that of 15 examples of giant-celled sarcoma, in which calcification or ossification is not noted, only one was characterized by secondary growths. Hence the prognosis of the latter is as favourable as is the prognosis of some other neoplasms which are considered to be of an innocent nature.

2. How far the mineral salts present in the primary tumour may behave as transporters of the infecting material which gives rise to the secondary growths in the lungs and elsewhere is, of course, open to criticism. That they are active agents in the general dissemination of the disease would not seem improbable from a consideration of the foregoing statements, from which it may be observed that metastatic tumours were discovered in 57.14 per cent. of all instances of calcifying or ossifying myeloid sarcomas, while they were present in only 6.66 per cent. of simple giant-celled sarcomas. The calcareous metastasis itself is due to the absorption of the salts of the imperfect bone of the primary growth, which are set free by a process precisely similar to that which I have already described under the head of the mode of development of these tumours. Saturated, as these salts must be, with the juice or fluid constituents of the original growth, it is not difficult to conceive that they act as the seed of infection of the cells of the parenchyma of the organs to which they are carried, and thereby give rise to secondary nodules, which present the same histological peculiarities as the mother tissue. Be this as it may, however, the fact remains that the calcifying and ossifying sarcomas, whether central or periosteal in origin, are, with the exception of the pure periosteal spindle-celled, and round-celled, the most malignant of all the neoplasms of the long bones.

The duration of life of the subjects of giant-celled sarcoma of the long bones is very variable. In a few instances death has occurred in three, four, five, and six months, while in others it has been postponed for many years, and recoveries are recorded ten and even fifteen years after operation. Unfortunately the cases which pursued a natural course are too few to be of any value in estimating the average duration of life, and in determining whether or not life is prolonged by surgical interference. Of 51 cases, of nearly all of which I have complete histories, only 3 ran a natural course. Of these, 1, that of Dr. Brown,[1] died of general erysipelas, ten years after the first appearance of the disease; in one reported by Peulevé,[1] the patient died of debility at the end of nine months and a half; while the third, which occurred in the practice of Carville,[2] terminated fatally from broncho-pneumonia in nine months.

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[1] Ante.

Accurate statements of the duration of the disease up to the date of operation and of the prolongation of life after operation are given in 44 of the remaining 48 cases,[3] from which it appears that the duration of life varied from three months to sixteen years and a half, the average having been 40.9 months, the majority of the patients being still alive at the date of the reports. 33 patients[4] remained well for periods which ranged from a few weeks to fifteen years after the operation,[5] while 15 died from the effects of surgical interference. Hence the average duration of life from the first observation of the disease among the 28 subjects[6] who survived resection or amputation was 54.8 months, or rather more than four years and a half.

Among the recoveries, that recorded by Bristowe deserves particular notice, as secondary deposits in the lungs might naturally have been anticipated from the condition of the neighbouring bloodvessels. After amputation at the shoulder, on account of a myeloid sarcoma of the head of the humerus, the anterior flap was seen to contain numerous veins, of the size of a goose-quill, which passed from the tumour into the substance of the deltoid muscle, and were filled with soft, pulpy growths, which were composed of giant cells. After the operation a considerable portion of the flap sloughed, and it was thought highly probable that the slough included all the diseased veins. On death from phthisis, five years subsequently, there were no evidences of metastatic deposits.

As I have already pointed out, recovery after operation is liable to be permanent, since of the 22 patients previously alluded to who underwent surgical treatment, 17 remained well for periods which ranged from eight months to fifteen years, the average being 58.7 months; while in 5 in which general infection occurred, the average duration of life after operation was $8\frac{3}{5}$ months. In all of the latter the lungs were affected secondarily, and, in 4, there was also recurrence locally, these phenomena appearing on an average, at rather more than six months after surgical interference.

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[1] Bull. Soc. Anat. Ser. 2, vol. x. p. 658.

[2] Ibid., ser. 2, vol. xii. p. 475.

[3] Cases 1, 10, 11, and 13 of the table are omitted, as definite information on one or the other of these points is wanting.

[4] This number includes the 28 cases of the table, and the 5 instances of recurrence of the disease after recovery from operations.

[5] In the table, where "recovered" alone is mentioned under the head of "later history," I have assumed that the patient was well four weeks after surgical treatment.

[6] The cases of generalization are included in this computation, and cases 1, 10, 11, and 13 of the table are excluded; but it is interesting to note that the patients were alive, respectively, 2, 6, 4, and "many years" after surgical interference.

The previous duration of the disease appears to exert an influence upon local and general recurrence, since in the cases of permanent cure the tumour had existed, on an average, 25 months before operation, while in the cases of recurrence, the average duration before operation was 16½ months. In the latter cases, also, the tumour had acquired a large volume in a short space of time, so that the general rule may be established that a rapidly growing myeloid sarcoma is more liable to prove malignant than one which runs a slow course.

While it is doubtless true, as Virchow declares,[1] that in myeloid, as in the other varieties of sarcoma, there is a period during which the tumour remains innocent, and is amenable to surgical treatment, and that early and effectual removal is the only measure to guard against recurrence, general pathology fails to indicate what that period is. Indeed, it may be accepted as an axiom that early operations are not more successful in prolonging life than those practised at a late date. In the cases of recurrence, for example, the disease had existed, respectively, two, five, seven, ten, and fifty-eight months; four, therefore, having been subjected to operation within a year from the first observation of the growth, and yet local and general infection and death ensued just as rapidly in the cases of five and ten months' duration, as in the case of fifty-eight months of existence. So, too, an inspection of the table of recoveries demonstrates that the best results are obtained when operations had been practised at comparatively late periods. Hence the prognosis rests less upon the time of operation after the first appearance of the disease, than upon the histological construction of the tumour. If, after removal, the latter is found to be free from calcareous and osseous degeneration, it may safely be assumed that the disease will not return, whereas if those transformations are present, the chances are against the patient.

Giant-celled sarcomas give rise to symptoms which, while they vary according to the size and consistence of the tumour, are, unfortunately, not distinctive. Hence their diagnosis is often exceedingly difficult and embarrassing.

In 50 per cent. of all cases the disease is ushered in by pain, which is usually of a dull aching character, but is occasionally lancinating and very severe, and is succeeded by a firm, immovable swelling in the vicinity of a joint. In 31 per cent. of all cases pain and tumefaction are observed simultaneously; while in 19 per cent. the affection begins insidiously, swelling alone being the first sign noticed by the patient.

Having once formed, the tumour grows, as a rule, slowly and continuously; is free from pain and tenderness; the temperature is not elevated, the overlying skin is normal in texture, colour, and mobility; and the subcutaneous veins and lymphatic glands are not enlarged.

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[1] Op. cit., p. 340.

To these general statements the following exceptions must be noted: in 29 per cent. of all cases the tumour increases rapidly, while in 6 per cent. its growth is temporarily arrested; in 40 per cent. the pain perseveres throughout the entire course of the affection, being commonly moderate, rarely continuous, and only severe and harassing in about one-third of the cases, when it generally depends upon implication of the corresponding articulation; in 14 per cent. the neoplasm is tender to the touch, but, as a rule, only slightly so; the temperature is elevated in 6 per cent.; the skin is altered in 33 per cent., the most common changes being discoloration and tenuity, ulceration being a curiosity; the lymphatic glands are the seat of tumefaction, from irritation, in 16 per cent.; while, finally, the subcutaneous veins are much enlarged in 27 per cent. of all cases.

The tumour itself has a spherical or ovoid form, and its surface is generally smooth and regular, although it may be bosselated or lobed. If its constituent elements have not undergone retrograde metamorphoses, and if its investing capsule be merely membranous, its consistence is firm, tense, and elastic; but, in the event of cystic, hemorrhagic, or advanced fatty changes, it is soft, and apparently fluctuating. Should the capsule be partly periosteal and partly bony, as usually happens, it will feel hard, and perhaps crackle, at some points, and elastic, or soft, or fluctuating at others; while, if it be completely osseous, as occurs in about 16 per cent. of all cases, it will be densely hard, although when the shell of bone is thin, parchment-like crepitation is elicited, or fracture even occurs under manipulation. On exploratory puncture blood nearly always issues, and sometimes freely, especially if the growth be very vascular or pulsates. In other instances, the fluid of softening cysts escapes from the artificial opening. In rare cases pus may even appear, as in two examples the tumour was found to be suppurating.

Pulsation when present, as it was in 20 per cent. of all the cases of which I have complete histories, is a most valuable sign, since it has not been observed in other neoplasms, whether central or peripheral, of the long bones, excepting six examples of the other varieties of central sarcoma, five of which occupied the shafts, and one the epiphysis, and in one case of osteoid sarcoma surrounding the lower end of the femur. Allusion is, of course, made to pulsation resident in the growth itself, and not to pulsation transmitted to it from contiguous arteries. It has not, curiously enough, been met with in myeloid tumours of the bones of the upper extremity; but has been recorded four times in giant-celled sarcoma of the head of the tibia,[1] four times in the condyles of the femur,[2] and in the upper and lower epiphysis of the fibula, respectively, once.[3]

Finally, a large, immovable, spherical, slowly-growing, probably painful, and possibly pulsating tumour, of varying degrees of consistence, occurring in the articular extremity of a long bone, between the fifteenth and fortieth years, or at about the twenty-eighth year, unattended by changes in the integuments, or by enlargement of the subcutaneous veins and lymphatic glands, and not marked by impairment of the general health, may be pronounced to be a giant-celled sarcoma.

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[1] Cases of Labbé, Chassaignac, Sirus-Pirondi, and Lücke.

[2] Cases of Billroth, Godlee, Carville, and Robin.

[3] Cases of Langston Parker, and Langenbeck.

In the treatment of this class of tumours, general measures being worthless, no time should be lost in resorting to amputation or excision. Although surgical interference has been followed by a mortality of 31.25 per cent. there can be no reasonable doubt that it has frequently succeeded in preventing local and systemic infection, as well as prolonging life. The more rapid the growth of the tumour, the more reason there is for early operation. Indeed, in view of the difficulty in determining the true nature of the neoplasm in its incipient stages, delays are extremely dangerous, since, instead of having to deal with a pure myeloid sarcoma, the disease may eventually prove to be an osteoid sarcoma, or a small-celled medullary sarcoma, in which events, valuable time will have been lost, and the patients have been exposed to the dangers of local infection and general dissemination.

In selecting an operation the golden rule should be observed to go as far as possible from the seat of disease, without needlessly jeoparding life. The reasons for this line of conduct will be perfectly clear, if it be remembered that the overlying soft parts, the contiguous bones, and even the joints, may be involved by extension of the disease. Hence it is that when operations have been practised next the trunk, or in close proximity to the tumours, the prognosis is bad, as, in the event of recurrence, nothing more can be done. In the cases of Henry[1] and Hutchinson,[2] for example, in which, respectively, disarticulation at the shoulder, and excision of one-third of the humerus had been practised for myeloid tumours of that bone, there was recurrence in the stump, and in the lungs. So, too, in a case in which Langenbeck[3] resected eight inches of the humerus for a tumour, as large as the double fist, which had perforated its capsule and extended processes between the muscular fibres of the flap. On death from exhaustion, ten weeks subsequently, the muscles of the supra and infraspinous fossæ of the scapula were found to be the seat of sarcomatous tubers. In all of these cases, diseased tissue had escaped the action of the knife, and precisely the same thing may happen if a limb be removed in its continuity too close to the morbid growth.

From these considerations I would establish the following general rules for guidance in selecting the point at which amputation should be performed:—

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[1] Trans. Path. Soc., Lond., vol. ix. p. 367.

[2] Ibid., vol. viii. p. 351.

[3] Langenbeck's Archiv, vol. i. p. 142, case v., and Gurlt's Jahresbericht für 1860-61, p. 532.

For tumours of the lower epiphyses of the tibia and fibula, just below the knee; when the upper epiphyses of these bones are affected, through the lower third of the thigh; at the junction of the upper and middle thirds of the thigh for disease of the condyles; at the hip-joint for that of the upper extremity of the femur; below the elbow for tumours of the lower epiphyses of the radius and ulna; through the lower third of the arm when the upper epiphysis of the ulna is affected; at the junction of the upper and middle thirds of the arm for disease of the condyles of the humerus; and at the shoulder joint when the head of the humerus is involved.

In the event of the neoplasm being small, for example, not larger than an orange, it will not be necessary to go so high up. .For a tumour of that size occupying the lower end of the tibia or fibula, the leg may, with great propriety, be amputated through its middle. On the other hand, a voluminous tumour may require the incisions to be made farther off. Thus, a growth, as large as the head, commencing in the lower extremity of the radius, had best be removed by disarticulation at the elbow.

Instead of amputation, excision of an entire joint, or of the affected epiphysis, along with the shaft, of the more slender long bones may be resorted to, particularly if the tumour presents a uniformly smooth surface, and is of a firm, dense consistence, or is inclosed in an osseous shell. Under these circumstances the surrounding tissues will, most probably, be found to be free from involvement; whereas, if the morbid growth is bosselated, and soft and elastic, or apparently fluctuating, the neighbouring structures will be likely to be implicated, and amputation should be selected. In cases of doubt, excision may be commenced, and removal of the limb be substituted for it, if the capsule of the tumour is discovered to be perforated, and the soft parts infiltrated by the morbid product. If the periosteum of the adjacent bone is firmly adherent to the capsule of the neoplasm, or if the bone is eroded, the latter should also be excised, since, in these conditions, it is liable to be the seat of sarcomatous deposits.

These general statements are illustrated by the following abstracts of all the cases that I have collected of excision of myeloid sarcomas. The subjects in all, except the eighth case, were females, and in four the tumours were voluminous:—

Case I.[1]—Langenbeck excised, antiseptically, seven inches of the ulna, four inches of the humerus, and the head of the radius, on account of a tumour, as large as a man's head, of the upper extremity of the ulna. The end of the humerus was deprived of its cartilage, and its spongy tissue exposed. In the latter was embedded an isolated, soft, dark-red nodule, of the size of a cherry, which was made up of giant, spindle, and round cells. Forty catgut ligatures were required to arrest the hemorrhage. The woman was well two years subsequently, but the arm was of little use.

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[1] Case 24 of table.

CASE II.[1]—From a female, aged 26 years, Langenbeck removed, antiseptically, nearly four inches of the lower end of the ulna, for a tumour in that situation, of three months' standing, and as large as the fist. High febrile excitement set in, the joint suppurated, and was itself excised on the seventh day. Death, however, ensued under pyæmic symptoms.

CASE III.—[2]Langenbeck excised three-fourths of the ulna for a tumour, inclosed in a perfect bony capsule, which began in the lower end of that bone. The woman was in perfect health at the expiration of four years.

CASE IV.—[3]Mr. Lucas removed the lower half of the ulna for a growth which extended two inches and a half above the wrist-joint, the latter of which was left intact, as it was protected by the triangular articular fibro-cartilage. Eight months subsequently the woman had free use of her hand, employing it in all her household work, the movements of pronation and supination being perfect.

CASE V.—[4]For a tumour of the lower end of the radius, Mr. Morris excised about four inches of both the radius and ulna, the latter of which was closely attached to the osseous capsule of the growth. The woman was alive eight months afterwards, but the limb had to be supported by a splint, and was practically useless.

CASE VI.—[5]Langenbeck excised, antiseptically, one-half of the fibula, along with a myeloid sarcoma, as large as a child's head, which started in its upper epiphysis. Forty catgut ligatures were applied to the divided vessels, and the woman was well eight months subsequently.

CASES VII. and VIII. are those of Langenbeck and Hutchinson, previously alluded to, in which the upper extremity of the humerus was the seat of the disease. In the former, eight inches of the bone were resected, but death occurred in two months from exhaustion due to profuse suppuration. In the latter, one-third of the bone was excised, along with the acromion and coracoid processes, which, however, were not implicated. The arm was bidding fair to be useful, but death occurred in five months from local and general recurrence.

CASE IX.—[6]In consequence of amputation having been declined, Billroth excised six inches of the lower extremity of the femur. The patient, a girl, 17 years old, died of pyæmia on the twenty-sixth day.

From an operative standpoint, little can be said in favor of excision, except when the lower end of the ulna is involved in a small tumour, and the interarticular cartilage can be preserved, through which the wrist-joint remains unopened. In a case of this description, Mr. Lucas succeeded in giving his patient a useful limb, while in the remaining recoveries the limbs were simply incumbrances. Besides, the mortality after excisions is greater by 3 per cent. than after amputation, notwithstanding the fact that the former was practised on the bones of the upper extremity, except in two instances, while the thigh was the seat of the majority of the amputations.

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[1] Langenbeck's Archiv, vol. xxi. supp. p. 331.

[2] Case 11 of table.

[3] Case 16 of table.

[4] Case 17 of table.

[5] Case 25 of table.

[6] Billroth, Chir. Klinik, Wien., 1869–70, p. 367.

Whatever operation be selected, if it be conducted near the seat of the disease, the surgeon should be prepared to encounter considerable hemorrhage. Thus in cases I. and VI. of the excisions, not less than forty ligatures were required, while in the case of Professor Gross (see p. 41) of disarticulation at the shoulder, the loss of blood was so great, despite compression of the subclavian artery, that death ensued in two hours.

ARTICLE II.

THE SUDDEN DEAFNESS OF SYPHILIS, WITH CASES.

BY SAMUEL SEXTON, M.D., Surgeon to the New York Ear Dispensary, Aural Surgeon to the New York Eye and Ear Infirmary.

WRITERS on aural affections have long known that invasions of the ear by syphilis were not of uncommon occurrence, and the prevailing opinion has been that the seat of the lesion is usually in the labyrinth. Better knowledge of the disease, however, seems to lead to the conclusion that its chief, if not entire, location is in the middle ear and its conductive mechanism. At the beginning of this century, especially in England and France, there was a sudden increase in otological literature,[1] if it deserves that name, and the references to "constitutional deafness," which included aural affections, having their origin in syphilis, are frequent.

Mr. Saunders,[2] whose work in 1806 fairly represented the then existing views on this subject, says (page 95, *et seq.*), "The whole class of the diseases to which the internal part of the ear is subject may be denominated nervous deafness," and after describing the distressing and peculiar tinnitus which characterizes "nervous deafness," he goes on to say, "Being forcibly struck with the congruity between deafness produced by syphilis, and the concomitant symptoms of nervous deafness, I could not avoid concluding, that although the remote cause be different, the proximate cause is the same in each," and "When the syphilis is cured, the effect is often irremovable, and the injury to the function of the affected organ permanent. There is a period, therefore, at which syphilitic deafness is irremediable, and this is more remarkably the case with nervous deafness." Saunders having satisfied himself that the proximate cause of syphilis and nervous deafness was the same, determined to try the success of an analogous treatment in a recent case of "nervous deafness." The patient selected was J. Waiton, who applied to Mr. Saunders at the Dispensary for

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[1] Vide Works of Saunders, London, 1806; Curtis, London, 1819; Wright, London, 1829; Caswell, London, 1833, and Itard, Paris, 1821; Deleau, Paris, 1822; Saissy, Paris, 1827, etc. etc.

[2] Treatise on the Ear, first American edition, Phila. 1821.